



U.S. Coast Guard

Field Sampling Plan (Rev 3.0)

For Site Evaluation

- Groundwater and Soil

USCG Atwater Facility

Detroit, Michigan

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Field Sampling Plan

For Site Evaluation -Groundwater and Soil

USCG Atwater Facility
Detroit, Michigan

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1. Introduction

This Field Sampling Plan (FSP) was prepared by Tetra Tech NUS, Inc. (Tetra Tech) on behalf of the U.S. Coast Guard (USCG) for the USCG Atwater Facility (Site) located in Detroit, Michigan (Figure 1-1). This FSP is intended to guide Site characterization activities to be consistent with the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300 and to supplement the Quality Assurance Project Plan (QAPP) (TtNUS, 2010) and Quality Assurance Project Plan Addendum (QAPPA) (TtNUS, 2011) for the USCG property divestiture program. U.S. Environmental Protection Agency (U.S. EPA) has concurred with the QAPP and QAPPA. A summary of previous investigations is presented on Table 1.

Based on previous investigations metals and polynuclear aromatic hydrocarbons (PAHs) impacts are potentially present at concentrations greater than the Michigan Department of Environmental Quality (MDEQ) residential soil and groundwater criteria screening level for soil constituents provided in the MDEQ Remediation and Redevelopment Division Generic Cleanup Criteria and Screening Levels. The soil and groundwater analytical results generated during the Site evaluation will be evaluated with respect to naturally occurring background concentrations and applicable or relevant and appropriate requirements (ARARs) to determine if PAH and metal concentrations in soil and groundwater at the Site pose a risk to receptors.

The screening levels referenced in this document are only intended to help guide the characterization and delineation of potential impacts to soil and groundwater, if present. If necessary, based on Site evaluation results, the USCG will identify and evaluate ARARs, to be considered (TBC) guidance, and select removal action objectives (RAOs) as part of an Engineering Evaluation/Cost Analysis (EE/CA) for the Site.

Prior to the CERCLA activities, USCG conducted two site investigations at the Atwater site with TtNUS. The first was a Phase I Environmental Site Assessment conducted in 2001. This assessment identified four potential areas of concern: possible asbestos - containing building materials, one former AST area, an oil and gas storage area, and the filled - in slip area. TtNUS then conducted a Phase II investigation where seven soil samples were collected. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and RCRA metals. Although a few semivolatiles and metals exceeded MDEQ Michigan residential soil criteria, results were within an acceptable range for the current heavy industrial zoning classification of the area. Samples were collected in various locations laterally around the property and up to 9 feet below ground surface (bgs). Based on the sample results there were no areas of significant environmental concern requiring rectification prior to transfer of the

property and TtNUS had no further recommendations at that time. The 2002 Tetra Tech Phase I and II Environmental Site assessment (ESA) Report is included as Appendix E. CERCLA investigation activities by Tetra Tech began in April 2010. Based on previous investigations soils were the only media sampled during this event. Figure 3 shows exceedences from all three investigations.

In 2006, Enviro Matrix (EM) conducted a Phase I and II of the site for the Economical Development Corporation of the City of Detroit. The Phase I indicated three potential recognized environmental conditions (RECs) exist at the site. The RECs identified were: Fill of unknown origin may have been brought into the parcel, the property has been used by the USCG and other unknown uses dating back to the late 1800s, and a history of heavy industrial activities in the area. Subsequently, EM conducted a Phase II site investigation. Five soil borings were advanced and six soil samples were collected for PAHs, metals (Michigan 10) and one location was analyzed for VOCs. This investigation identified elevated PAHs and metals greater than the most restrictive MDEQ criteria. Samples were collected in various locations laterally around the property and up to 10.5 feet bgs. The 2006 Enviro Matrix II ESA Report is included as Appendix F.

Boring logs in both the Tetra Tech and EM ESA reports note the presence of clay and/or clayey soils throughout the site. The regional geology in the vicinity of the Detroit River is noted to have significant amount of lacustrine clay. Typically, this clay is very stiff and demonstrates low permeability. In borings advanced during the EM ESA (maximum depth of 22 feet bgs), field conditions did not produce large enough quantities of groundwater to collect adequate samples. Therefore, no groundwater samples were collected. Because of the low expected permeability of this clay and previous observations, no groundwater sampling was previously proposed.

During the April 2010 field investigation by Tetra Tech, fifteen borings were advanced for soil sample collection, and four borings (DASB102, DASB106, DASB110, and DASB112) were advanced to 15 feet bgs and left open overnight to monitor the accumulation of groundwater (Figure 4). Water accumulated in DASB102, DASB110, and DASB112. DASB106 did not accumulate any water but had caved in overnight and may not be representative of the area. Based on this information four permanent monitoring wells will be installed and sampled.

This FSP is intended to be used in conjunction with other supporting documents including the QAPPA (Tt NUS, 2011). The objective of this FSP is to develop an approach that will characterize the nature and extent of the contamination, if present. This will include demonstrating that impacts potentially present have been adequately delineated horizontally and vertically to generate accurate surface area and volume

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estimates of impacted soil. Area and volume estimates will be used to evaluate cleanup approach and feasibility. This evaluation will be performed and documented in the Site Investigation Report followed by an Engineering Evaluation/Cost Analysis (EE/CA) and a Removal Action Work Plan (RAWP) based on results of the Site evaluation and intended future land use and ownership. Additionally, based on results from the groundwater investigation, groundwater remediation and/or future monitoring will be determined.

1.1 Document Organization

This FSP describes the project setting and Site history, and presents the sampling objectives and anticipated project schedule. It also provides procedures for:

- Establishing soil sampling and monitoring well locations
- Sample collection for laboratory analyses
- Quality assurance and quality control
- Sample handling and management
- Waste management
- Documentation

Field work will be conducted in accordance with the Site-specific Health and Safety Plan (HASP) provided in Appendix A. Standard Operating Procedures (SOPs) for Site evaluation activities are provided in Appendix B. Example field reports including soil boring logs, monitoring well construction logs, and groundwater sampling logs are included in Appendix C.

1.2 Project Setting

Activity on the USCG Atwater Facility property began prior to 1897 in Detroit, Michigan (see Figure 1 and Figure 2). The property covers approximately 1.26 acres of harbor front land in downtown Detroit. No buildings are currently on the site. The former maintenance building and garage were demolished around 2004. The site is predominantly covered with asphalt with a small grassy area. A fence with a locked gate is located along Atwater Street and a fence is located on the eastern and western sides of the property to restrict access to the site. The general site location is depicted

in Figure 1, Site Location Map. A site map of the Detroit Atwater Property is provided as Figure 2.

1.2.1 Cultural Resources Survey

No cultural resource survey has been performed at the Site.

Because minimal disturbance will occur during boring activities no cultural resources site survey is anticipated.

1.2.2 Threatened or Endangered Species Assessment

No threatened or endangered species assessment has been performed at the Site. Information is available on the Department of Natural Resources (DNR) website referencing the state and federally threatened and endangered species. Table 2 identifies the threatened and endangered species located in Wayne County, Michigan.

Because minimal disturbance will occur during boring activities, no threatened and endangered species assessment will be conducted. Care will be taken while advancing soil boring to make sure there is no damage to vegetation in the project area.

1.2.3 Environmental Site Assessments

Two environmental site assessments were conducted at the Atwater site. The first was a Phase I and II Environmental Site Assessment for Detroit Atwater conducted by Tetra Tech, Inc. in May of 2001 (Table 1). At the time, there were two buildings on the site near East Atwater Street, the warehouse/training building and a 6-car garage. An above ground fuel tank that was located about halfway down the dock along the eastern side of the long slip was not present. The assessment identified four potential areas of concern: possible asbestos - containing building materials, the former AST area, oil and gas storage area, and the filled - in slip area. Tetra Tech then conducted a Phase II investigation where seven soil samples were collected. Samples were analyzed for VOCs, SVOCs, and RCRA metals. Although a few semivolatiles and metals exceeded MDEQ Michigan residential soil criteria, results were within an acceptable range. Samples were collected in various locations laterally around the property and up to 9 feet bgs. Based on the sample results there were no areas of significant environmental concern requiring rectification prior to transfer of the property and had no further recommendations at this time (TtNUS, 2002).

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Geologic information at the site was identified during the Phase I as being located within the southeastern part of the Michigan Basin. The Michigan Basin received shallow- to deep-water sediments throughout much of the Paleozoic Era (extending from the Ordovician through the Pennsylvanian Periods). Lithologically, the sediments deposited during this time period produced a vast thickness of sandstones, siltstones, shales, limestones and evaporites. Based on generalized geologic mapping of the state (modified from Martin, 1957, Geological Map of Michigan), bedrock underlying the facility consists of the Lower Middle Devonian-age Dundee Limestone that typically ranges in thickness from 40 to 160 feet (TtNUS, 2002).

Geologic conditions at the Detroit Atwater site were characterized as part of the Phase II ESA. The shallow subsurface lithology of the site was characterized to a depth of 9 feet and consists of 4 to 4.5 feet of fill and concrete overlying 4 feet of gravelly to organic clay. Soil obtained beneath the clay layer from 8 to 9 feet below ground surface is characterized as gravelly to silty sand (TtNUS, 2002).

The second Phase II Environmental Site Assessment prepared for the Economical Development Corporation of the City of Detroit, was conducted by Enviro Matrix in July 2006 (Table 1). The Phase I indicated three potential RECs exist at the site. The RECs identified were: fill of unknown origin may have been brought into the parcel, the property has been used by the USCG and other unknown uses dating back to the late 1800s, and a history of heavy industrial activities in the area. Subsequently, Enviro Matrix conducted a Phase II site investigation five soil borings were advanced and six soil samples were collected for polycyclic aromatic hydrocarbons (PAHs), metals (Michigan 10) and one location was analyzed for VOCs. This investigation identified elevated PAHs and metals greater than the most restrictive MDEQ. Samples were collected in various locations laterally around the property and up to 10.5 feet bgs (Enviro Matrix, 2006).

During the Phase II activities soil was also logged and reported. At this time no buildings were located onsite (buildings were demolished) and a few of the samples were collected within the footprint of the former garage and office. Dark brown topsoil was noted from 0.5' to 1.5' bgs. Below topsoil or paving was fill consisting of silty sand, silty clay, or variegated clay layers to approximately 4.0' to 17.5' bgs. Discoloration was observed throughout the fill. Below the fill was clayey sand, sandy silty clay, or sandy clay to the depth of the boring (ranging from 15.5' to 25.5' bgs) (Enviro Matrix, 2006).

Moist soil was encountered in every boring at depths ranging from 3.5' to 22.0' bgs. Moist soil was expected based on the close proximity of the site from the Detroit River.

The zone encountered did not produce sufficient volume to assess the hydrological features or collect groundwater samples (Enviro Matrix, 2006).

During the April 2010 investigation by Tetra Tech, fifteen borings were advanced and soil samples were collected at two depth intervals: immediately below the surface (approximately 0 to 2 feet bgs) and immediately above the water table (approximately 3 to 5 feet bgs). These samples were analyzed for metals and PAHs, and several contaminants were detected at concentrations greater than Michigan DNRE criteria (Figure 4). Additionally, four borings (DASB102, DASB106, DASB110, and DASB112) were advanced to 15 feet bgs and left open overnight to monitor the accumulation of groundwater (Figure 4). Water accumulated in DASB102, DASB110, and DASB112. DASB106 did not accumulate any water but had caved in overnight and may not be representative of the area. Based on this information and other field observations, USEPA requested the installation of permanent monitoring wells.

1.3 FSP Objective

The primary objectives of this FSP are as follows.

- Provide procedures for field sample collection to characterize Site soil including the nature and extent constituent impacts in soil in accordance with the Code of Federal Regulations (CFR) 40 CFR 300.410 Removal Site Evaluation.
- Provide procedures for installation of permanent monitoring wells and collection of groundwater samples.

1.4 Project Schedule

The USCG has established an anticipated project timeline of through October 2012 that includes preparation of an EE/CA to be used for site remediation to prepare the Site for property transfer to the City of Detroit as part of the River Walk development.

2. Site Evaluation Soil Sampling

PAHs and metal impacts to soil are present based on previous investigations and historic site activities. Therefore, Site evaluation samples will be collected using biased with locations identified as described in the following sections. Procedures for soil sample collection are summarized in Sections 5.1 and 5.2 and defined in the SOP provided in Appendix B. Procedures and methods for laboratory analysis are defined in the QAPP (TtNUS, 2010).

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Prior to the advancement of soil borings, site utilities will be cleared.

2.1 Biased Soil Sample Locations

Because of temperature issues for samples from eight borings from the April 2010 sampling event, these locations will be resampled in 2011. These sample locations are underlined on Figure 4. Biased Site evaluation sampling will incorporate a single phase approach of lateral and vertical delineation samples as described in the following Sections 2.1.1 and 2.1.2.

Data reporting and validation levels referenced in the following sections are defined in the QAPP Worksheet 14 (TtNUS, 2010).

2.1.1 Initial Evaluation Soil Samples

Initial evaluation samples were collected during the ESA investigations at locations based on previous site activities. During the Tetra Tech ESA field investigation, soil samples were collected in the vicinity of an area noted on old drawings as an Oil and Gas Storage Area, in the vicinity of a former above ground gasoline storage tank, and from the fill material used to backfill a portion of the eastern slip. During the EM ESA field investigation, soil samples were collected within the footprints of the former warehouse/training building and 6-car garage and also from the fill material used to backfill a portion of the eastern slip.

2.1.2 Delineation Soil Samples

2.1.2.1 Vertical and Lateral Delineation Soil Samples

Potential impacts have been identified in surface soils (0 to 6 inches) and subsurface soils (up to 10.5' bgs) during previous Site evaluation. Therefore, samples will be collected from multiple depths at each location utilizing Direct Push Technology (DPT) at locations indicated on Figures 3 and 4. During boring advancements the soil will be screened using the PID and visual observations. Soil samples will be continually screened until groundwater is reached, approximately 5 feet bgs. At each boring, one sample will be collected from the 0-2 foot interval (or the two-foot interval below the bottom of the pavement) and from a two-foot interval directly above the groundwater table and submitted for laboratory analysis for PAHs and mercury in accordance with procedures and methods indicated in Section 6 and the Site-specific QAPP.

The reporting for the vertical delineation sample results will include a Level 2 data package and validation in accordance with the Site-specific QAPP. The data will be

used to define the vertical extent of soil impacts, if present, and to estimate the depth of soil removal areas if warranted.

100 percent of the initial soil evaluation samples adjacent to Site structures will be collected and submitted for laboratory analysis of PAHs and mercury in accordance with procedures and methods indicated in Section 6 and defined in the Site-specific QAPP (TtNUS, 2010).

2.1.2.2 Lateral Delineation Soil Samples

See preceding section.

2.2 Unbiased Soil Sample Locations

Not applicable.

2.3 Background Soil Sample Locations

Not applicable.

3. Site Evaluation Groundwater Sampling

Boring logs in both the Tetra Tech and EM ESA reports note the presence of clay and/or clayey soils throughout the site. The regional geology in the vicinity of the Detroit River is noted to have significant amount of lacustrine clay. Typically, this clay is very stiff and demonstrates low permeability. In borings advanced during the EM ESA (maximum depth of 22 feet bgs). In previous field investigations it was reported that field conditions did not produce large enough quantities of groundwater to collect adequate samples. Therefore, no groundwater samples were collected.

In April 2010 Tetra Tech conducted a site investigation of the soil. During this investigation no groundwater sampling was planned. DASB102, DASB106, DASB110, DASB112 were advanced to 15 feet bgs and left open overnight for observation (Figure 4). On the following day, groundwater was observed in DASB102, DASB110, and DASB112. DASB106 caved in overnight, so no water level measurement was obtained. Based on field observations, USEPA requested the installation of monitoring wells.

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3.1 Monitoring Well Locations

Four monitoring wells will be installed at the site in the upper subsurface aquifer in locations where, based on previous investigations, groundwater is anticipated to produce. Figure 4 shows the locations where wells are anticipated to be installed. They will be positioned as follows:

- DAMW01 - The northeast corner of the site close to Atwater Street. This will be the upgradient well closest to the property boundary. This location is near DASB105 which was observed to be wet at approximately 5 feet bgs and mostly sand.
- DAMW02 - The eastern corner near the end of the dock, where concentrations of metals and PAHS in soil are relatively low. This location is next to DASB102 which was left open overnight to monitor water accumulation. Four feet of water was observed in this location.
- DAMW03 is located in the middle of the site near soil borings with high concentrations of metals. This location is near DASB110 which was left open overnight to monitor water accumulation. Approximately 5.2 feet of water was observed in this location.
- DAMW04 is located in a downgradient part of the site. This well will be installed outside of the thick concrete pad that was found during the April 2010 sampling event. This location is near DASB112 which was left open overnight to monitor water accumulation. Approximately 5.6 feet of water was observed in this location.

3.2 Groundwater Samples

Groundwater samples will be collected from each of the monitoring wells installed on-Site using low-flow purging and sampling techniques. Samples will be submitted for laboratory analysis of Michigan 10 total and dissolved metals and PAHs (SW-846 6020A, 7470A, and 8270C). Procedures for groundwater sample collection are summarized in Section 5.5 and detailed in the SOP provided in Appendix C. The groundwater samples will be submitted for Level 3 data reporting and validation as defined in the QAPPA (TtNUS, 2011).

4. Removal Confirmation Sampling

Removal confirmation sampling will be performed following the soil removal action at the Site to confirm successful removal of soils impacted at concentrations above the RAO. All removal confirmation sample results, including removal area bottom and sidewall samples, will include Level 3 data reporting and validation.

The approximate size and shape of each soil removal area will be determined based on results of the Site evaluation/delineation sampling. Following removal of the anticipated volume of soil impacted at concentrations above the RAO, removal area sidewall samples will be collected and field screened using the XRF if lead is a chemical of concern (COC).

4.1 Bottom Samples

Based on previous sampling results it is anticipated that soil will be removed to the groundwater table; therefore bottom sampling will not be necessary. However, if removal is conducted to a depth above the groundwater table the following procedures for bottom sampling will be implemented.

Removal area bottom samples will be collected after the anticipated depth of each excavation is reached. Bottom samples will be collected based on a biased sampling approach at a minimum frequency of approximately two samples per 1,000 square feet of excavation footprint, with a minimum of two bottom samples per discrete excavation. Removal confirmation bottom samples will be biased toward locations that exhibited the highest reported COC concentration within each excavation area based on Site evaluation data. Cleanup levels will be determined in the EE/CA and included in the Removal Action Work Plan.

The depth of soil removal areas will be determined by results of the field screening. Bottom samples will first be field screened using the XRF analyzer. If XRF field screening results indicate potential impacts (i.e., results greater than the cleanup level identified in the Removal Action Work Plan), additional soil will be removed and subsequent bottom samples collected as described in Section 4.3. If results of the field screening are less than the cleanup level, the samples will be sent to the laboratory for confirmatory analysis. A similar approach will be used in the evaluation of the results of the analysis for other COCs.

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4.2 Sidewall Samples

Removal area sidewall samples will be collected once the anticipated lateral extent of each excavation is reached. Sidewall samples will be collected at a minimum frequency of approximately one sample per 25 linear feet of sidewall, with a minimum of one sample per sidewall (four samples per discrete excavation). Removal confirmation sidewall samples will be biased toward locations that exhibited the highest reported COC concentration within each excavation area based on Site evaluation data. Cleanup levels will be determined in the Engineering Evaluation/Cost Analysis (EE/CA) and included in the Removal Action Work Plan.

The extent of soil removal areas will be determined by results of the field screening. Sidewall samples will first be field screened using the XRF analyzer. If XRF field screening results indicate potential impacts (i.e., results greater than the cleanup level identified in the Removal Action Work Plan), additional soil will be removed and subsequent sidewall samples collected as described in Section 4.3. If results of the field screening are less than the cleanup level, the samples will be sent to the laboratory for confirmatory analysis. A similar approach will be used in the evaluation of the results of the analysis for other COCs.

4.3 Over-excavation

If results of the XRF field screening and other analyses on bottom or sidewall samples indicate potential residual soil impacts (i.e., XRF results greater and analytical results than the cleanup levels) additional soil will be removed, and subsequent sidewall and/or bottom samples will be collected. Soil removal will be terminated at each location once results of the bottom and sidewall sample field screening are less than the cleanup level. The final sidewall and bottom samples collected from each location will be submitted for laboratory analysis of COCs to confirm removal of soil impacted at concentrations above the RAO. All removal confirmation samples will require level 3 data reporting and validation as defined in the QAPPA (TtNUS, 2011).

4.4 Waste Characterization Samples

4.4.1 Investigation

Investigation – derived waste (IDW) samples will also be collected and submitted for laboratory analysis of TCLP metals, TCLP VOCs, and pH. A composite sample for each media will be collected from the drums used to containerize IDW. One sample will be collected from the soil drum of the most contaminated well location, and a second will be a composite from the aqueous drums. After analytical results are

received, the IDW will be transported and disposed of at an appropriate licensed facility.

4.4.2 Removal Action

If removal action is warranted based on previous Site evaluation and/or field screening activities, soil samples will be collected from each area of proposed soil removal action during the Site evaluation activities for waste characterization. Waste characterization samples will be representative of the material being removed and will be evaluated by compositing discrete samples within each potential removal area.

A portion of each sample collected for delineation of impacts (i.e., the initial sample[s] identified by field screening to contain elevated lead concentrations and each of the vertical and lateral delineation samples collected in that area) will be submitted for laboratory compositing and subsequent waste characterization analysis. The samples will be laboratory-composited to provide sufficient homogenization and to be representative of soils that will be removed from that area. The laboratory-composited samples will be analyzed for total lead and Toxicity Characteristic Leaching Procedure (TCLP) lead and any other analyses described in the Removal Action Work Plan. The lead concentration in the TCLP leachate will be compared to the toxicity characteristic criteria of 5 milligrams per liter (mg/L), to determine if the soil to be removed is a characteristic hazardous waste.

A decontamination water composite sample will also be collected and submitted for laboratory analysis of TCLP lead and any other analyses described in the Removal Action Work Plan. The composite sample will be collected from the drum(s) used to containerize decontamination water. After analytical results are received, the decontamination water will be transported and disposed of at an appropriately licensed facility.

5. Field Procedures

No variations are expected at this time.

5.1 X-Ray Fluorescence Field Screening

Field screening of soil samples will be conducted using a an Innov-X (model Alpha 4000) portable XRF analyzer in accordance with USEPA Method 6200 for ex-situ field screening for lead using XRF (USEPA, 2007) provided in Appendix D.

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In this procedure, the portion of soil selected for field screening is prepared by placing a volume of soil into a disposable plastic re-sealable bag. Any large pieces of soil within the plastic bag are broken into smaller pieces, and the soil is blended to form as homogeneous a mixture as is practical. Each sample will be screened by placing the XRF analyzer onto the sample for 30 seconds to obtain comparable results among the samples. XRF analyzer results will be recorded in instrument units that are equivalent to parts per million.

Quality control measures described in the attached USEPA Method 6200 will be employed to provide the highest quality data possible from the XRF analyzer. In addition to these measures, duplicate samples will be collected for all XRF field screening samples at a rate of 1 per 10 samples to assess and document the variability (i.e., measurement error) of the instrument.

A copy of the Innov-X (model Alpha 4000) Specification Sheet is included in Appendix D.

5.2 Soil Sample Collection

Based on previous investigations it is anticipated that soil sample collection will be performed using a DPT rig.

Soil samples collected for laboratory analysis will be collected using a decontaminated stainless steel or disposable plastic scoop to fill the appropriate containers. The SOP for soil sample collection is provided in Appendix B.

Soil samples will be collected as discrete or “grab” samples. The sampling procedure will meet USEPA sampling requirements using properly decontaminated or disposable sampling equipment. Reusable equipment will be decontaminated in accordance with procedures described in Section 5.6 prior to each use.

Soil samples will be representative of the overall soil matrix at each sample location and will be generally free of organic material and gravel unless that material represents the primary soil type at the particular sample location. Portions of samples intended for laboratory analysis will be placed in the appropriate laboratory-supplied containers, labeled, and stored on ice as described in Section 8 to await shipment to the laboratory.

5.3 Monitoring Well Installation

Hollow-stem auger or drilling techniques capable of creating a minimum 4-inch diameter borehole will be utilized for installing monitoring wells. Soil will be continuously logged and classified at each location to confirm the lithology identified during the background soil type characterization described in Section 2.3.1. The observations collected during installation will be used to determine the monitoring well screen interval placement and to make sure wells are screened within the appropriate hydrogeologic unit. Based on the April 2010 investigation groundwater is anticipated at 5 feet bgs. To best screen the shallow groundwater zone wells will be installed approximately 13 to 14 feet bgs. This allows the top of the groundwater zone to be approximately in the middle of the 10 foot screen and leave enough space for an appropriate sand pack and seal.

5.4 Monitoring Well Construction and Development

Prior to monitoring well construction, the utilities will be located and marked out in the proposed monitoring well locations. At a minimum a 10 by 10 foot area will be cleared to make sure that the location is free of underground utilities.

Monitoring wells will be constructed of 2-inch, Schedule 40 polyvinyl chloride (PVC) casings and 10-foot-long, 0.01-inch slot PVC screens. A primary filter pack of clean silica sand will be installed flush with the bottom of the well to a minimum of 12 inches above the top of the well screen. A sand passing U.S. Standard Sieve No. 20-30 will be used for finer formations (0.010-inch slot size) and/or coarser sand (U.S. Standard sieve No. 16-30) will be used with 0.020-inch slot size screens in coarser formations. The annulus surrounding the screen will be backfilled using an appropriately sized sand pack for the slot size and surrounding hydrogeologic unit to 2 feet above the top of the well screen. The remainder of the borehole annulus will be backfilled with bentonite chips to 2 feet below surface. Monitoring wells will be completed with a sealable locking cap and a flush-mount manhole type cover or aboveground protective cover (considering current and future land use) set into a concrete pad. Well construction details will be recorded on a Monitoring Well Construction Log and maintained in the project file.

Well development will be performed using a surge-block and vacuum pump or decontaminated submersible pump to remove fines and reestablish hydrologic communication with the surrounding hydrogeologic unit. Proper development of monitoring wells is critical to obtaining high-quality representative groundwater samples. The pump intake will be moved up and down throughout the 10-foot screen interval to make sure development of the entire screen interval. A field turbidity meter

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will be used to determine turbidity during development. Wells will be developed until a turbidity of 10 nephelometric turbidity units (NTU) is achieved, with a minimum of 10 casing volumes purged from each well. Visual observations of the purge water, along with field turbidity measurements and the volume of water purged from the well, will be recorded in the field log book or on well development logs. All monitoring well construction and development will be completed in accordance with the SOP provided in Appendix C.

5.5 Groundwater Sample Collection

The groundwater samples laboratory analysis will be collected using a peristaltic pump under low-flow purging and sampling conditions as described in the Low-Flow Groundwater Sampling SOP provided in Appendix C. Groundwater sampling will be performed after sufficient time has passed since well development to allow for artificially suspended soil particles to settle out of suspension (i.e., approximately 2 weeks).

The groundwater samples will be collected as discrete or “grab” samples. Dedicated tubing constructed of polyethylene (or other inert material) will be used for each well. Groundwater purging will be performed by lowering the tubing to the midpoint of the well screen. Groundwater will be purged at a rate that minimizes drawdown in the well, not to exceed 500 milliliters per minute. A Horiba U-52 or equivalent will be used with a flow-through cell to measure and record water quality field parameters including pH, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential (ORP). A separate instrument will be used to measure turbidity.

Groundwater samples will be collected in the appropriate laboratory-supplied pre-preserved containers once field parameters have stabilized (typically 2 to 3 consecutive readings within 10%) and 2 to 3 consecutive turbidity measurements below 10 NTUs. Samples collected for total lead analysis will be field preserved at the time of sample collection. Samples collected for dissolved lead analysis will be field-filtered using an appropriately sized filter (i.e., 0.45 micron) to allow naturally suspended colloidal particles to pass, and preserved immediately following filtration. The water quality field parameters will be recorded in the field log book or on groundwater sampling logs. Groundwater samples will be placed in the appropriate laboratory-supplied containers, preserved, labeled, and stored on ice to await shipment to the laboratory.

5.6 Equipment Decontamination and Investigation-Derived Waste Management

All reusable equipment will be decontaminated in accordance with the SOP for Decontamination provided in Appendix B. Reusable sampling equipment will be decontaminated prior to the first use and in between each sampling location.

All loose soil will be removed from soil sampling equipment. The sampling equipment will then be placed in a bucket with a detergent and distilled water solution and scrubbed to remove any residual soil. Sampling equipment will then be rinsed in a bucket of distilled water or steam cleaner. Finally, the sampling equipment will be removed from the rinse water and given a final rinse of distilled water from a spray bottle. Both the detergent wash and clean water rinse solutions will be periodically changed as needed.

Decontamination fluids will be collected for containerization and disposal. Small-sized equipment will be decontaminated in a bucket. Decontamination water from the DPT and HSA rig will be captured either by a clean tub or by plastic sheeting supported below by boards to create a basin. The decontamination water will then be transferred to an IDW drum. If plastic sheeting is used, the sheeting will be drummed with the rest of the IDW.

All IDW such as soil, spent decontamination fluids, well development water, and purge water will be placed in labeled new, steel 55-gallon drums. The drums will be securely sealed, labeled, and will remain at the Site pending receipt of laboratory results. All drums will be removed from the Site and properly disposed of within 30 days of receipt of IDW sample laboratory analysis.

5.7 Site Survey

All sample locations and relevant Site-specific features will be recorded using traditional survey techniques by a Michigan-licensed surveyor. The existing USCG base map and coordinate system for the Site will be utilized, and all soil sample and permanent monitoring well locations will be surveyed and tied into existing Site benchmarks for accuracy. The survey data will be used to update the existing USCG Site maps. The top of casing elevation for each monitoring well will be surveyed to an accuracy of 0.01 feet.

Field Sampling Plan - Groundwater and Soil

USCG Atwater Facility,
Detroit, Michigan

6. Analysis

All soil samples will be submitted to Trimatrix Laboratories, Inc. for analysis of PAHs and mercury by USEPA Method SW-846 8270C (PAHs) and SW-846 7471A (Mercury).

All groundwater samples will be submitted to Trimatrix Laboratories, Inc. for analysis of PAHs and metals (total and dissolved) by USEPA Method SW-846 8270C (PAHs), SW-846 6020A (Michigan 10 Metals), and 7470A (Mercury).

IDW samples will be submitted to Trimatrix Laboratories, Inc. for analysis of TCLP/VOCs, TCLP/metals, and pH.

The laboratory sample preparation, extraction, and analytical methods for each of these analyses are summarized in QAPP Worksheet 20 (TtNUS, 2010) and QAPPA Worksheet 20G (TtNUS, 2011).

7. Quality Assurance/Quality Control

Quality Assurance/Quality Control (QA/QC) procedures, including field and analytical procedures, equipment calibration, chain-of-custody requirements, sample containers and preservatives, and QA/QC sample types and frequency, are defined in the Site-specific QAPPA (TtNUS, 2011) .

Analytical results for Site samples (including lateral and vertical delineation samples if needed) will include Level 3 data reporting and validation. The data reporting and validation levels are defined in the QAPP Worksheet 14 (TtNUS, 2010) and QAPPA Worksheet 14G (TtNUS, 2011).

8. Sample Handling and Management

All samples will be handled according to the chain-of-custody protocol described in the QAPP Worksheet 27 (TtNUS, 2010) and QAPPA Worksheet 27G (TtNUS, 2011).

8.1 Sample Information

Samples being shipped for laboratory analysis will be labeled with the sample identification information, date of sample collection, and requested analysis. Samples will be placed in a cooler on ice to await shipment to the laboratory.

8.2 Sample Designation System

Samples collected at the Site will be identified according to the following USCG sample identification system:

8.2.1 Soil Samples

Each sample submitted to the laboratory for chemical analysis shall be assigned a unique sample identification number. The sample identification number will consist of a four segment, alpha-numeric code that identifies the site, sample type (medium) and location, and sample depth.

The alpha-numeric coding to be used in the sample identification system is as follows:

Field Samples

(AA) - (AA) - (NNN) - (NNNN)

(Site Name) - (Sample Type) - (Sample Location) - (Sample Depth)

Character Type: A - Alphabetic; N – Numeric

Site Name: “DA” – Detroit Atwater

Sample Type: SB – Subsurface soil sample (SS would be used for surface and shallow subsurface soil sample); IDW – Investigation-derived Waste.

Sample Location: Soil boring number (e.g., 101A, 102A, 103A, etc. – corresponding to the boring number from the April 2010 sampling event). For drums, drum number 001, 002, etc.

Sample Depth: The first two digits is the top of the sampling interval in feet bgs and the second two digits is the bottom of the sampling interval.

Using this nomenclature scheme, the following is an example for a subsurface soil sample collected from 2-4 feet deep at location number 109: DA-SB-109A-0204.

Field Sampling Plan - Groundwater and Soil

USCG Atwater Facility,
Detroit, Michigan

8.2.2 Groundwater Samples

Each sample submitted to the laboratory for chemical analysis shall be assigned a unique sample identification number. The sample identification number will consist of a four segment, alpha-numeric code that identifies the site, sample type (medium) and location.

The alpha-numeric coding to be used in the sample identification system is as follows:

Field Samples

(AA) - (AA) - (NN) - (NNNNNN)

(Site Name) - (Sample Type) - (Sample Location) - (Event)

Character Type: A - Alphabetic; N – Numeric

Site Name: "DA" – Detroit Atwater

Sample Type: MW – Monitoring Well (Groundwater)

Sample Location: Groundwater (e.g., 01, 02, 03, etc. - consecutive numbering for each sample location).

Event: Month and year, for example an event in September 2010 would be 092010.

Using this nomenclature scheme, the following is an example for a groundwater sample collected: DA-MW-01-092010.

8.2.3 QA/QC Samples

FD - Field Duplicate

QA sample designations will be blind relative to field duplicates. Other pertinent information regarding sample identification will be recorded in the field log books and sample log sheets.

Using this nomenclature scheme, the following is an example for the first field duplicate groundwater sample collected: DA-SB-FD-01. The location of sample would be noted in the field logbook.

8.3 Sample Packaging and Shipping Requirements

Samples shipped to the laboratory via overnight courier will be packed inside a cooler, with bubble wrap and ice, in a manner to prevent breakage of sample containers. Sample containers will be securely sealed to prevent damage or loss of the sample. Additional detail regarding sample packaging and shipping requirements is provided in QAPP Worksheet 27 (TtNUS, 2010) and QAPP Worksheet 27G (TtNUS, 2011).

The Chain-of-Custody form will be completed by the sampler and sealed inside the cooler during shipment. Custody seals will be placed on the outside of the cooler. Sample coolers will be properly labeled and shipped according to U.S. Department of Transportation requirements.

9. Waste Management

Based on results of the IDW samples, IDW generated during the Site evaluation will be disposed of at an appropriately licensed facility. IDW exhibiting contaminant concentrations less than TCLP criteria and pH between 2 and 12.5 will be managed as non-hazardous solid waste. Soils exhibiting contaminant concentrations greater than TCLP criteria or pH less than or equal to 2 or pH greater than or equal to 12.5 will be managed as hazardous waste. Existing data suggests that IDW will be non-hazardous waste.

All disposable personal protective equipment (PPE) and sampling supplies will be disposed of with IDW.

10. Documentation

All Site activities will be recorded in a Site-specific field notebook or on Field Report Logs. Included in the documentation will be procedures used for sampling and other activities, weather conditions, personnel working on the Site, and a chronological log of Site activities. Copies of the Chain-of-Custody form, Field Report logs, Soil Boring Logs, Well Construction Logs, Groundwater Sampling Logs and Equipment Calibration logs are provided in Appendix C.

Field Sampling Plan - Groundwater and Soil

USCG Atwater Facility,
Detroit, Michigan

11. References

- Enviro Matrix. 2006. *Phase II Environmental Site Assessment. Prepared for: Economic Development Corporation of the City of Detroit.* July 2006.
- National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule. 40 Code of Federal Regulations, Part 300. March 8, 1990.
- TtNUS, 2002a. *Field Sampling Plan Phase II Environmental Site Assessment: Limited Soil and Sediment Sampling for Detroit Atwater.* July 2002.
- TtNUS. 2002b. *Phase I and II Environmental Site Assessment for Detroit Atwater. Revised.* December 2002.
- TtNUS, 2010. *Quality Assurance Project Plan.* March 2010.
- TtNUS, 2011. *Quality Assurance Project Plan Addendum Soil and Groundwater.* April 2011.
- USEPA. 1992. *Supplemental Guidance to RAGS: Calculating the Concentration Term.* May 1992.
- USEPA. 1994. Office of Solid Waste and Emergency Response. *Memorandum: Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities.* From Elliott Laws, Assistant Administrator. To: Regional Administrators I-X. EPA/540/F-94/043. August 1994.

Table 1
Atwater Facility Historical Data Summary

Date	Data	Summary/Comments
Late 1800's	Ownership obtained by the USCG	
2001	Phase I (TtNUS)	<ul style="list-style-type: none"> Identified four potential areas of concern: possible asbestos – containing building materials, the AST, oil and gas storage area, and the filled – in slip area.
2001	Phase II (TtNUS)	<ul style="list-style-type: none"> Collected 7 soil samples. PAHs and Metals were reported as exceedences.
2006	Phase I (Enviro Matrix)	<ul style="list-style-type: none"> Three RECs were identified: Fill of unknown origin may have been brought into the parcel, the property has been used by the USCG and other unknown uses dating back to the late 1800's, and heavy industrial activities in the area.
2006	Phase II (Enviro Matrix)	<ul style="list-style-type: none"> Five soil borings were advanced and six soil samples were collected. PAHs and metals were reported as exceedences.
Pending	EE/CA Investigation	<ul style="list-style-type: none"> Advance 15 soil borings to collect samples for PAHs and metals and delineate soil contamination; install 4 monitoring wells to characterize groundwater.

Table 2**Wayne County Threatened and Endangered Species List**

Current as of 10/8/2009

Scientific Name	Common Name	Federal Status	State Status
<i>Acipenser fulvescens</i>	Lake sturgeon		T
<i>Adlumia fungosa</i>	Climbing fumitory		SC
<i>Alasmidonta marginata</i>	Elktoe		SC
<i>Ambystoma texanum</i>	Smallmouth salamander		E
<i>Ammocrypta pellucida</i>	Eastern sand darter		T
<i>Ammodramus henslowii</i>	Henslow's sparrow		E
<i>Ammodramus savannarum</i>	Grasshopper sparrow		SC
<i>Angelica venenosa</i>	Hairy angelica		SC
<i>Arabis missouriensis</i> var. <i>deamii</i>	Missouri rock-cress		SC
<i>Aristida longespica</i>	Three-awned grass		T
<i>Aristolochia serpentaria</i>	Virginia snakeroot		T
<i>Asclepias hirtella</i>	Tall green milkweed		T
<i>Asclepias sullivantii</i>	Sullivant's milkweed		T
<i>Betula populifolia</i>	Gray birch		SC
<i>Calephelis mutica</i>	Swamp metalmark		SC
<i>Camassia scilloides</i>	Wild hyacinth		T
<i>Carex squarrosa</i>	Sedge		SC
<i>Castanea dentata</i>	American chestnut		E
<i>Clemmys guttata</i>	Spotted turtle		T
<i>Clinostomus elongatus</i>	Redside dace		E
<i>Cyclonaias tuberculata</i>	Purple wartyback		T
<i>Diarrhena obovata</i>	Beak grass		T
<i>Eleocharis engelmannii</i>	Engelmann's spike rush		SC
<i>Epioblasma obliquata</i> <i>perobliqua</i>	White catspaw	LE	E
<i>Epioblasma torulosa</i> <i>rangiana</i>	Northern riffleshell	LE	E
<i>Epioblasma triquetra</i>	Snuffbox		E
<i>Eragrostis pilosa</i>	Small love grass		SC

Scientific Name	Common Name	Federal Status	State Status
<i>Euonymus atropurpurea</i>	Wahoo		SC
<i>Euphorbia commutata</i>	Tinted spurge		T
<i>Euphyes dukesi</i>	Dukes' skipper		T
<i>Falco peregrinus</i>	Peregrine falcon		E
Floodplain Forest			
<i>Fraxinus profunda</i>	Pumpkin ash		T
<i>Galearis spectabilis</i>	Showy orchis		T
<i>Gallinula chloropus</i>	Common moorhen		T
<i>Gentianella quinquefolia</i>	Stiff gentian		T
<i>Geum virginianum</i>	Pale avens		SC
Great Blue Heron Rookery	Great Blue Heron Rookery		
Great Lakes Marsh			
<i>Haliaeetus leucocephalus</i>	Bald eagle		SC
<i>Hybanthus concolor</i>	Green violet		SC
<i>Hydrastis canadensis</i>	Goldenseal		T
<i>Hypericum gentianoides</i>	Gentian-leaved St. John's-wort		SC
<i>Ixobrychus exilis</i>	Least bittern		T
<i>Jeffersonia diphylla</i>	Twinleaf		SC
<i>Juncus brachycarpus</i>	Short-fruited rush		T
<i>Juncus vaseyi</i>	Vasey's rush		T
<i>Justicia americana</i>	Water willow		T
<i>Lactuca floridana</i>	Woodland lettuce		T
Lakeplain Oak Openings			
Lakeplain Wet Prairie	Alkaline Wet Prairie, Midwest Type		
Lakeplain Wet-mesic Prairie	Alkaline Tallgrass Prairie, Midwest Type		
<i>Lampsilis fasciola</i>	Wavyrayed lampmussel		T
<i>Leucospora multifida</i>	Conobea		SC
<i>Liatris squarrosa</i>	Plains blazing star		X
<i>Liparis liliifolia</i>	Purple twayblade		SC
<i>Lycopodium appressum</i>	Northern prostrate clubmoss		SC
<i>Lycopus virginicus</i>	Virginia water-horehound		T
<i>Lysimachia hybrida</i>	Swamp candles		X

Scientific Name	Common Name	Federal Status	State Status
<i>Macrhybopsis storeriana</i>	Silver chub		SC
Mesic Sand Prairie	Moist Sand Prairie, Midwest Type		
Mesic Southern Forest	Rich Forest, Central Midwest Type		
<i>Mimulus alatus</i>	Winged monkey flower		X
<i>Morus rubra</i>	Red mulberry		T
<i>Moxostoma carinatum</i>	River redhorse		T
<i>Myotis sodalis</i>	Indiana bat	LE	E
<i>Nelumbo lutea</i>	American lotus		T
<i>Notropis anogenus</i>	Pugnose shiner		E
<i>Noturus miurus</i>	Brindled madtom		SC
<i>Noturus stigmosus</i>	Northern madtom		E
<i>Nycticorax nycticorax</i>	Black-crowned night-heron		SC
<i>Obovaria olivaria</i>	Hickorynut		E
<i>Obovaria subrotunda</i>	Round hickorynut		E
<i>Opsopoeodus emiliae</i>	Pugnose minnow		E
<i>Panax quinquefolius</i>	Ginseng		T
<i>Pantherophis gloydi</i>	Eastern fox snake		T
<i>Penstemon pallidus</i>	Pale beard tongue		SC
<i>Percina copelandi</i>	Channel darter		E
<i>Percina shumardi</i>	River darter		E
<i>Phaseolus polystachios</i>	Wild bean		X
<i>Platanthera leucophaea</i>	Prairie white-fringed orchid	LT	E
<i>Pleurobema sintoxia</i>	Round pigtoe		SC
<i>Polygala cruciata</i>	Cross-leaved milkwort		SC
<i>Pomatiopsis cincinnatiensis</i>	Brown walker		SC
<i>Potentilla paradoxa</i>	Sand cinquefoil		T
<i>Prosartes maculata</i>	Nodding mandarin		X
<i>Protonotaria citrea</i>	Prothonotary warbler		SC
<i>Quercus shumardii</i>	Shumard's oak		SC
<i>Rallus elegans</i>	King rail		E
<i>Rhexia virginica</i>	Meadow beauty		SC
<i>Ruellia humilis</i>	Hairy wild petunia		T

Scientific Name	Common Name	Federal Status	State Status
<i>Sagittaria montevidensis</i>	Arrowhead		T
<i>Sander canadensis</i>	Sauger		T
<i>Sanguisorba canadensis</i>	Canadian burnet		E
<i>Scirpus clintonii</i>	Clinton's bulrush		SC
<i>Scleria pauciflora</i>	Few-flowered nut rush		E
<i>Scleria triglomerata</i>	Tall nut rush		SC
<i>Silene virginica</i>	Fire pink		E
<i>Silphium laciniatum</i>	Compass plant		T
<i>Silphium perfoliatum</i>	Cup plant		T
<i>Simpsonia ambigua</i>	Salamander mussel		E
<i>Sistrurus catenatus catenatus</i>	Eastern massasauga	C	SC
<i>Sisyrinchium hastile</i>	Blue-eyed-grass		X
<i>Smilax herbacea</i>	Smooth carrion-flower		SC
<i>Speyeria idalia</i>	Regal fritillary		E
<i>Spiza americana</i>	Dickcissel		SC
<i>Sterna forsteri</i>	Forster's tern		T
<i>Sterna hirundo</i>	Common tern		T
<i>Strophostyles helvula</i>	Trailing wild Bean		SC
<i>Sturnella neglecta</i>	Western meadowlark		SC
<i>Stylurus laurae</i>	Laura's snaketail		SC
<i>Stylurus notatus</i>	Elusive snaketail		SC
<i>Stylurus plagiatu</i> s	Russet-tipped clubtail		SC
<i>Trillium recurvatum</i>	Prairie trillium		T
<i>Villosa fabalis</i>	Rayed bean	C	E
<i>Villosa iris</i>	Rainbow		SC
Wet-mesic Flatwoods			
<i>Wisteria frutescens</i>	Wisteria		T
<i>Zizania aquatica</i> var. <i>aquatica</i>	Wild rice		T

State Protection Status Code Definitions

E: Endangered
T: Threatened
SC: Special concern

Federal Protection Status Code Definitions

LE: Listed endangered

LT: Listed threatened

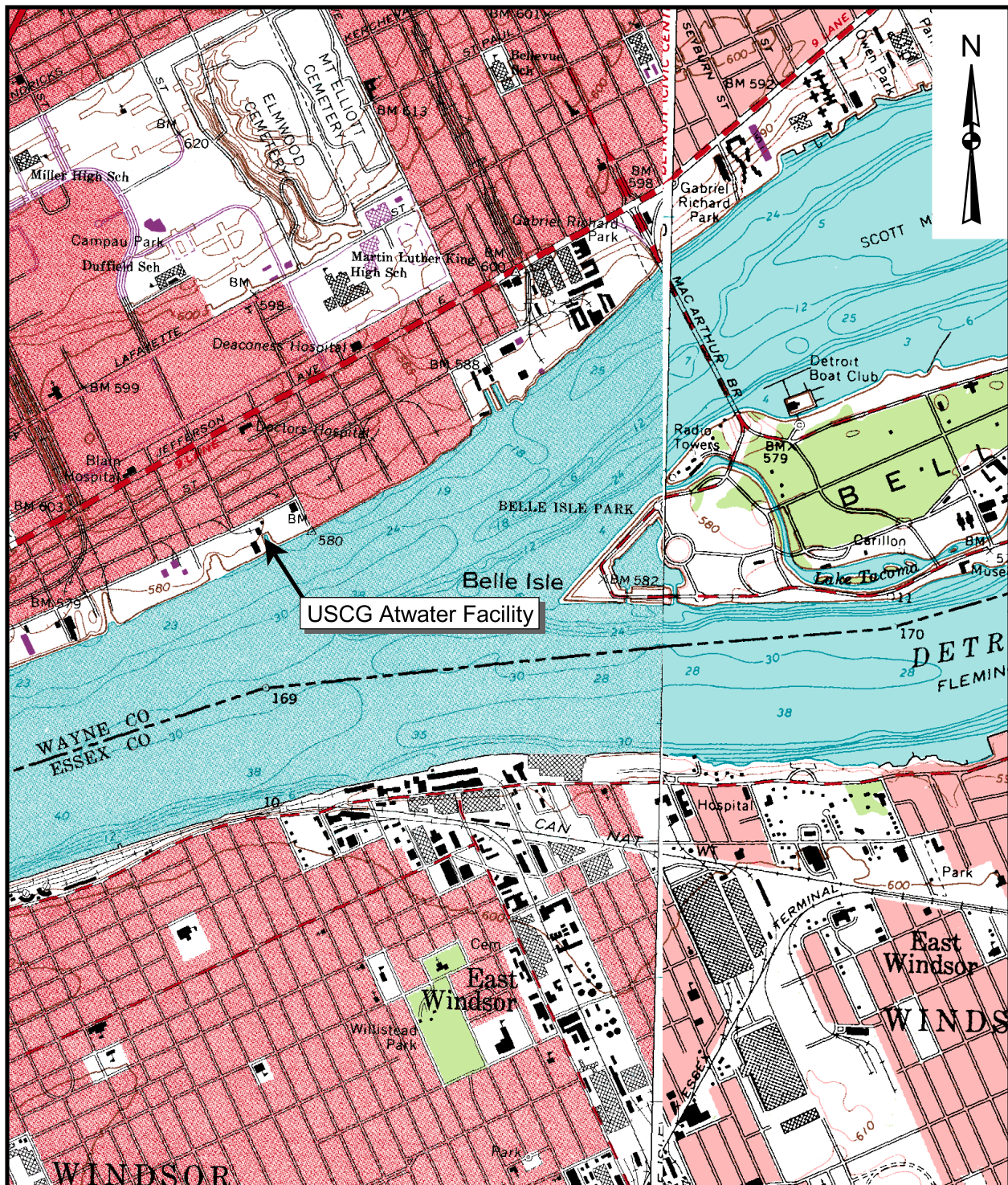
LELT: Partly listed endangered and partly listed threatened

PDL: Proposed delist

E(S/A): Endangered based on similarities/appearance


PS: Partial status (federally listed in only part of its range)

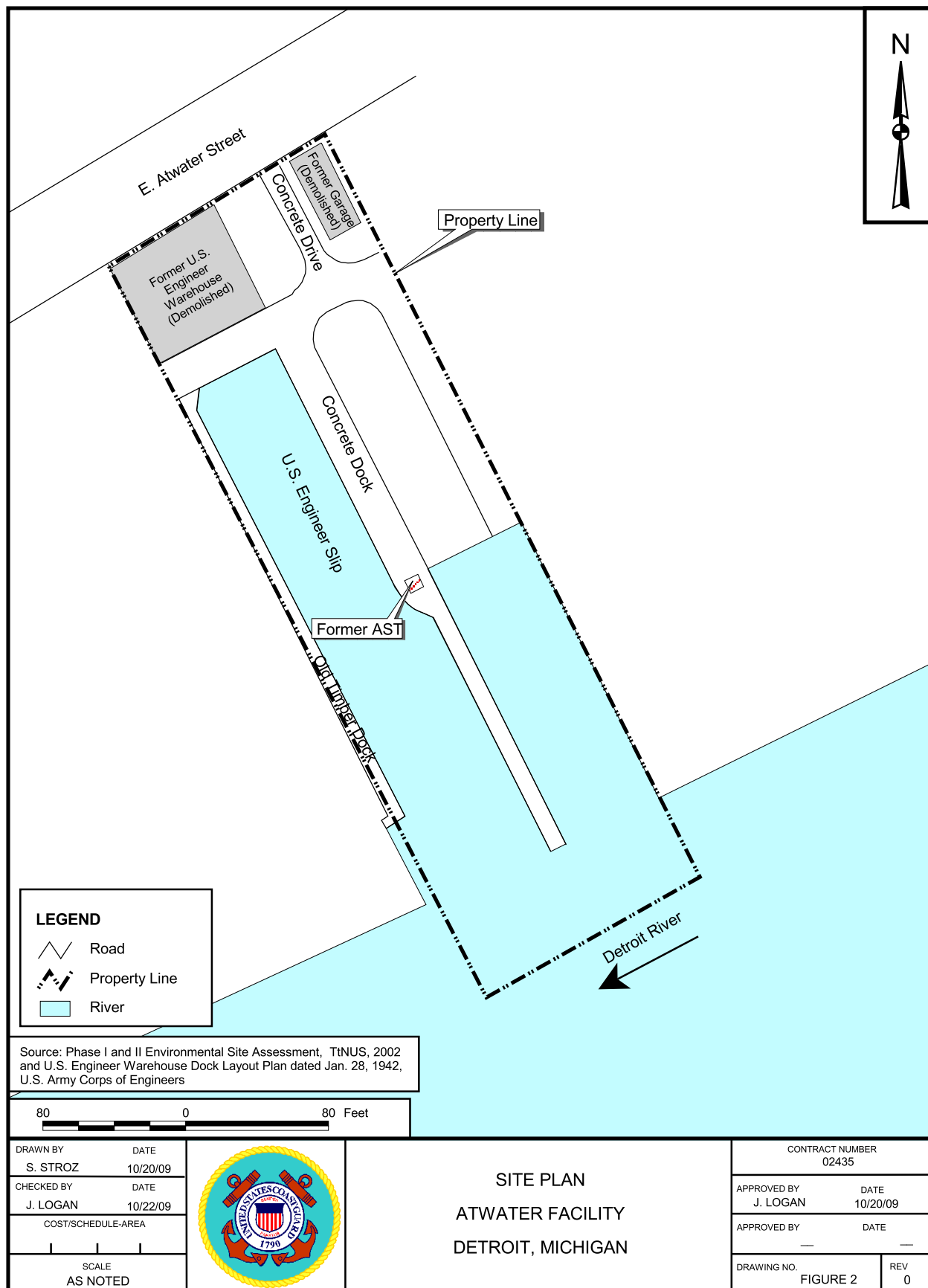
C: Species being considered for federal status

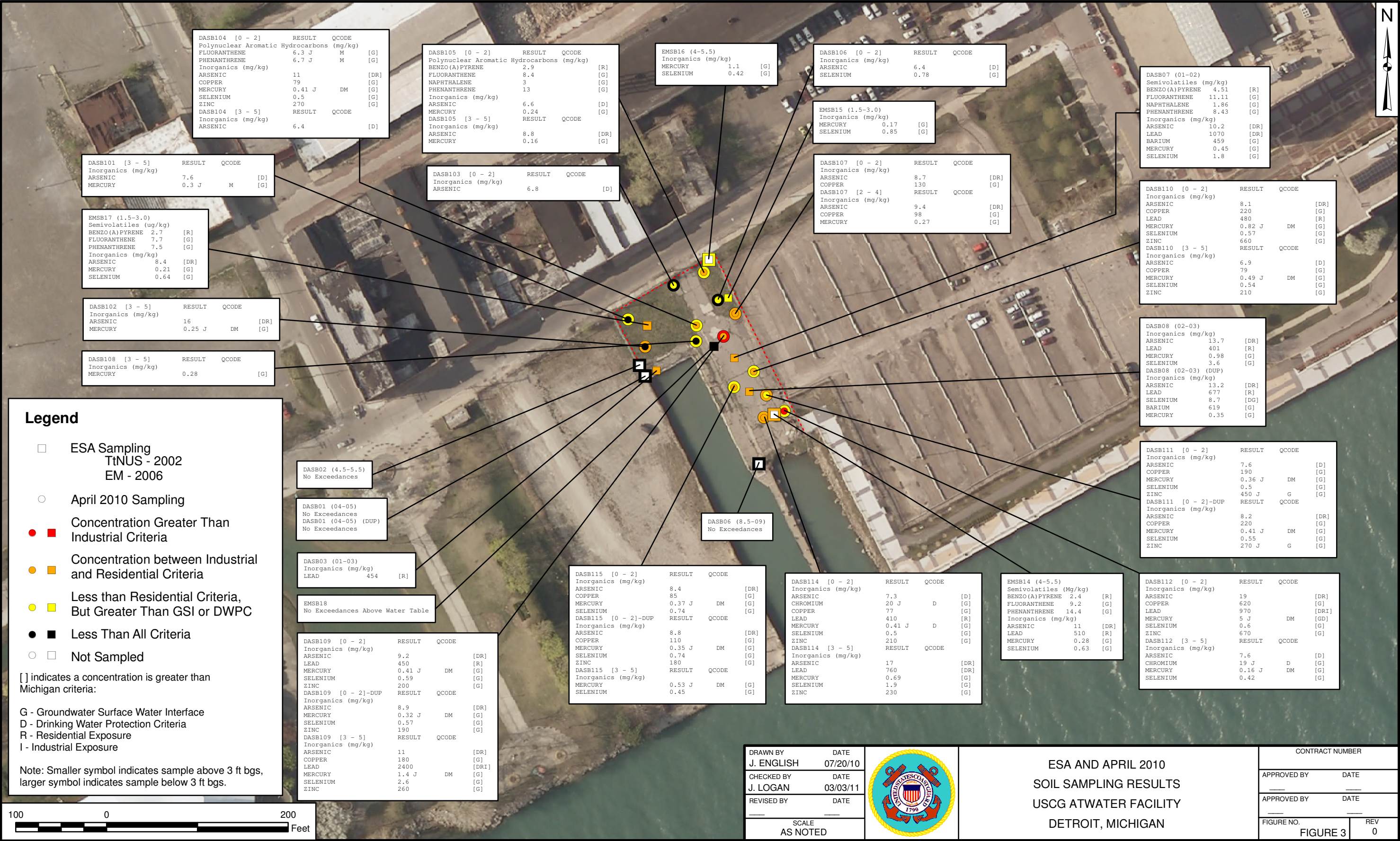


2000 0 2000 Feet

Source: USGS Detroit, MI, 7.5' Digital Raster Graph

DRAWN BY MJJ		DATE 27Apr01			SITE LOCATION MAP ATWATER FACILITY DETROIT, MICHIGAN		CONTRACT NUMBER 02435			
CHECKED BY J. LOGAN		DATE 10/22/09					APPROVED BY J. LOGAN		DATE 10/20/09	
COST/SCHEDULE-AREA							APPROVED BY			
SCALE AS NOTED				DRAWING NO. FIGURE 1				REV 1		





Appendix A

Health and Safety Plan

**Site Specific
Health and Safety Plan
for
Field Activities
at the**

**United States Coast Guard
Detroit Atwater Property**



**Commanding Officer
United States Coast Guard
Civil Engineering Unit
Project Number - 112G02435**

**Revision 1
August 2010**

**SITE SPECIFIC
HEALTH AND SAFETY PLAN**

FOR

**FIELD ACTIVITIES AT THE
UNITED STATES COAST GUARD
DETROIT ATWATER PROPERTY**

Submitted to:

**United States Coast Guard
Civil Engineering Unit Cleveland**

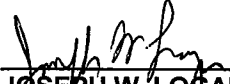
Submitted by:

**Tetra Tech NUS, Inc.
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Project # - 112G02435


**Revision 1
August 2010**

PREPARED UNDER THE DIRECTION OF:



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1.0 INTRODUCTION

The objective of this Health and Safety Plan (HASP) is to provide the minimum safety practices and procedures to Tetra Tech NUS (Tetra Tech) personnel conducting soil sampling, soil boring, and associated activities at the United States Coast Guard property at 2660 East Atwater Street, located in Detroit, Michigan.

This HASP has been prepared using the latest available information regarding known or suspected chemical contaminants and potential and foreseeable physical hazards associated with the planned work at this site. This HASP has been designed to be used in accordance with the Tetra Tech NUS Health and Safety Guidance Manual. The Guidance Manual provides detailed information pertaining to procedures to be performed on site as directed by the HASP, as well as Tetra Tech standard operating procedures.

This HASP has been written to support proposed tasks and techniques associated with the scope of work as presented in Section 4.0. Should the proposed work site conditions and/or suspected hazards change, or if new information becomes available, this document will be modified. Changes to the HASP will be made with the approval of the Tetra Tech CLEAN Health and Safety Manager (HSM) and the Project Manager (PM). The PM will notify affected personnel of changes.

The elements of this HASP are in compliance with the requirements established by OSHA 29 Code of Federal Regulations (CFR) 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER). The information contained in this plan, as well as policies on conducting on site operations, has been obtained from the Tetra Tech Health and Safety Program and US Coast Guard policies and procedures.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibilities for site safety and health for Tetra Tech and subcontractor employees conducting environmental sampling and other field activities. Personnel assigned to these positions shall exercise the primary responsibility for the on site health and safety. These persons will be the primary point of contact for any questions regarding the safety and health procedures and the selected control measures.

- The Tetra Tech PM is responsible for the overall direction and implementation of health and safety for this work.

- The Tetra Tech Field Operations Leader (FOL) is responsible for implementation of this HASP. The FOL manages field activities, executes the work plan, and enforces safety procedures, as applicable to the work plan. Specifically, the FOL will:
 - Verify training and medical status of on-site personnel in relation to site activities.
 - Assist and represent Tetra Tech with emergency services (if needed)
 - Provide elements of site-specific training for on site personnel.
- The Tetra Tech Site Safety Officer or their representative supports the FOL concerning the aspects of health and safety including, but not limited to:
 - Coordinating the health and safety activities
 - Selecting, applying, inspecting, and maintaining personal protective equipment
 - Establishing work zones and control points
 - Implementing air monitoring procedures
 - Implementing hazard communication, respiratory protection, and other associated safety and health programs
 - Coordinating emergency services
 - Providing elements of site-specific training
- Compliance with these requirements is monitored by the Project Health and Safety Officer (PHSO) and is coordinated through the HSM.

1.2 STOP WORK AUTHORIZATION

All employees are empowered, authorized, and responsible to stop work at any time when an imminent and uncontrolled safety or health hazard is perceived. In a Stop Work event (immediately after the involved task has been shut down and the work area has been secured in a safe manner) the employee shall contact the Project Manager and the Corporate Health and Safety Manager. Through observations and communication, all parties involved shall then develop, communicate, and implement corrective actions necessary and appropriate to modify the task and to resume work.

1.3 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: East Atwater Street **Address:** Detroit, Michigan

Site Point of Contact: Lynn Keller **Phone Number:** 216.902.6258

Purpose of Site Visit: soil sampling, soil boring, and associated activities

Proposed Dates of Work: August 2010 through completion

Project Team:

Tetra Tech NUS Personnel:
Joe Logan
TBD
TBD
Matthew M. Soltis, CIH, CSP
Jennifer Carothers, PhD
TBD
TBD

Discipline/Tasks Assigned:
Project Manager (PM)
Field Operations Leader (FOL)
Technical Expert
Health and Safety Manager (HSM)
Project Health and Safety Officer (PHSO)
Site Safety Officer (SSO)
Geologist

Subcontractor Personnel:

Discipline/Tasks Assigned:

Hazard Assessment (for purposes of 29 CFR 1910.132) for HASP preparation has been conducted by:

Prepared by: Jennifer Carothers, PhD

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an emergency. However, given the nature and scope of planned site activities, significant emergency situations are unlikely. In the event of an emergency, Tetra Tech personnel will provide emergency response support only to the capabilities of on site personnel. Emergency situations that are beyond the capabilities of on site Tetra Tech personnel will require assistance from outside emergency responders. In the event of emergencies that are beyond the capabilities of on site personnel, an evacuation will be initiated. In an evacuation, site personnel will move to a safe place of refuge and the appropriate emergency response agencies will be notified. The emergency response agencies listed in Table 2-1 of this plan are capable of providing the most effective response, and as such, will be designated as the primary responders. These agencies are located within a reasonable distance from the areas of site operations, which ensures adequate emergency response time. This emergency action plan conforms to the requirements of OSHA Standard 29 CFR 1910.38(a), as allowed in OSHA 29 CFR 1910.120(I)(1)(ii).

Tetra Tech personnel will, through the necessary actions, provide incidental response measures for incidents such as:

- Incipient Fire and spill prevention and response
- Removal of personnel from emergency situations
- Provision of initial medical support for injury/illnesses requiring only first-aid level support
- Provision of site control and security measures, as necessary

2.2 EMERGENCY PLANNING

Through the initial hazard/risk assessment effort, there is very minor potential for injury or illnesses resulting from exposure to chemical, physical, or other hazards, and subsequently little likelihood of emergency situations. To further minimize or eliminate potential emergency situations, pre-emergency planning activities associated with this project will be implemented. The FOL is responsible for:

- Coordinating response actions with Detroit Emergency Services personnel, if available, to ensure that Tetra Tech emergency action activities are compatible with existing facility emergency response procedures.

- Identifying a chain of command for emergency action.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.

2.3 EMERGENCY RECOGNITION AND PREVENTION

2.3.1 Recognition

Foreseeable emergency situations that may be encountered during site activities will generally be recognizable by visual observation. Visual observation will be the principal method of identifying any hazards that may be associated with the proposed scope of work. These potential hazards, the activities with which they have been associated, and the recommended control methods are discussed in detail in Sections 5.0 and 6.0 of this document.

2.3.2 Prevention

Tetra Tech personnel will minimize the potential for emergencies by ensuring compliance with the HASP, the Health and Safety Guidance Manual, applicable OSHA regulations, and by following directions given by those persons responsible for the health, safety, and welfare of site personnel.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

In the event that the site must be evacuated, personnel will immediately stop activities and report to a pre-determined safe place of refuge. The safe place of refuge may also serve as the telephone communication point, as communication with emergency response agencies may be necessary. Telephone communication points and safe places of refuge will be determined prior to the commencement of site activities and will be conveyed to personnel as part site-specific training and/or daily safety meetings. Upon reporting to the refuge location, personnel will remain there until directed otherwise by the Tetra Tech FOL or the On-Scene Incident Commander. The FOL will take a head count at this location to confirm the presence of site personnel. Emergency response agencies will be notified of any unaccounted for personnel.

2.5 EVACUATION ROUTES AND PROCEDURES

Once an evacuation is initiated, personnel will terminate site activities and proceed immediately to the designated place of refuge, unless doing so would further jeopardize the welfare of workers. In such an event, personnel will proceed to a designated alternate location and remain there until further notification

from the FOL. The use of these locations as assembly points provides communication and a direction point for emergency services, should they be needed.

2.5.1 Decontamination Procedures/Emergency Medical Treatment

During any site evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. Decontamination will be postponed if the incident warrants immediate evacuation.

Tetra Tech personnel will perform removal of personnel from emergency situations and may provide initial medical support for injury/illnesses requiring only first-aid level support. Medical attention above that level will require assistance and support from the designated emergency response agencies. Attachment I provides the procedure to follow when reporting an injury/illness, and the form to be used for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps provided in Figure 2-1.**

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

Since Tetra Tech personnel will be working in close proximity to each other, voice commands will comprise the mechanisms to alert site personnel of an emergency. If an incident occurs, site personnel will initiate the following procedures:

- Initiate incident alerting procedures (if needed) verbally.
- Describe to the FOL (who will serve as the Incident Coordinator) what has occurred and provide as many details as possible.
- If the FOL determines that the situation is beyond the capabilities of the site personnel emergency services will be contact using the emergency reference information listed in Table 2-1. Explain the situation and the appropriate emergency services will be dispatched. **Stay on the phone and follow the instructions of the emergency contact.**

FIGURE 2-1 POTENTIAL EXPOSURE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of exposure situations. In the event of a personnel exposure to a hazardous substance or agent:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure Report is attached).
- If the exposed person is a Tetra Tech employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. The care of the victim will be monitored by WorkCare physicians. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at (800) 455-6155 (enter Ext. 109), or follow the voice prompt for after hours and weekend notification, and be prepared to provide:
 - 1) Any known information about the nature of the exposure.
 - 2) As much of the exposure history as was feasible to determine in the time allowed.
 - 3) Name and phone number of the medical facility to which the victim(s) has/have been taken.
 - 4) Name(s) of the exposed Tetra Tech NUS, Inc. employee(s).
 - 5) Name and phone number of an informed site officer who will be responsible for further investigations.
- Fax appropriate information (e.g., MSDS) to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) and Human Resources Manager (Marilyn Duffy) at (412) 921-7090.

As environmental data is gathered and the exposure scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. This generalized summary will be accompanied by a personalized letter describing the individual's findings/results. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-1 (continued)
POTENTIAL EXPOSURE REPORT

Name: _____ Date of Exposure: _____

Social Security No.: _____ Age: _____ Sex: _____

Client Contact: _____ Phone No.: _____

Company Name: _____

I. Exposing Agent

Name of Product or Chemicals (if known): _____

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? _____

How long did individual work in area before signs/symptoms developed? _____

Was protective gear being used? If yes, what was the PPE? _____

Was there skin contact? _____

Was the exposing agent inhaled? _____

Were other persons exposed? If yes, did they experience symptoms? _____

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat

Tearing

Headache

Cough

Shortness of Breath

Chest Tightness / Pressure

Nausea / Vomiting

Dizziness

Weakness

Delayed Symptoms:

Weakness

Nausea / Vomiting

Shortness of Breath

Cough

Loss of Appetite

Abdominal Pain

Headache

Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat

Tearing

Headache

Cough

Shortness of Breath

Chest Tightness / Pressure

Cyanosis

Nausea / Vomiting

Dizziness

Weakness

Loss of Appetite

Abdominal Pain

Numbness / Tingling

Have symptoms: (please check off appropriate response and give duration of symptoms)

Improved: _____ Worsened: _____ Remained Unchanged: _____

V. Treatment of Symptoms (check off appropriate response)

None: _____ Self-Medicated: _____ Physician Treated: _____

2.7 EMERGENCY CONTACTS

Prior to performing work at the site, personnel will be thoroughly briefed on the emergency procedures to be followed in the event of an accident. As indicated earlier, Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table will be made readily available to site personnel and copies will be placed in each of the site vehicles.

**TABLE 2-1
EMERGENCY REFERENCE
DETROIT ATWATER**

AGENCY	TELEPHONE
Detroit Police/Fire/Rescue Services	911
Henry Ford Hospital	(313)-874-2839
Police	911
Fire Department	911
USCG Site Contact Lynn M. Keller, PMP	(216) 902-6258
Poison Control Center	(800) 222-1222
Michigan State One-Call (utility clearance)	(800)-482-7171
Chemtrec	(800) 424-9300
National Response Center	(800) 424-8802
Michigan DEQ (spill reporting)	800-292-4706
Project Manager Joe Logan	(412) 921-7231
Field Operations Leader, TBD	
Tetra Tech, Pittsburgh Office	(412) 921-7090
Health and Safety Manager Matthew M. Soltis, CIH, CSP	(412) 921-8912
Project Health and Safety Officer Matthew Springer, MPH and Jennifer Carothers, PhD	(412) 921-8089 and 8083

2.8 EMERGENCY ROUTE TO HOSPITAL

The closest hospital with an emergency room to East Atwater Street is Henry Ford Hospital. An area map showing the proximity of this site to the hospital is incorporated into this HASP as Figure 2-2. Directions are as follows:

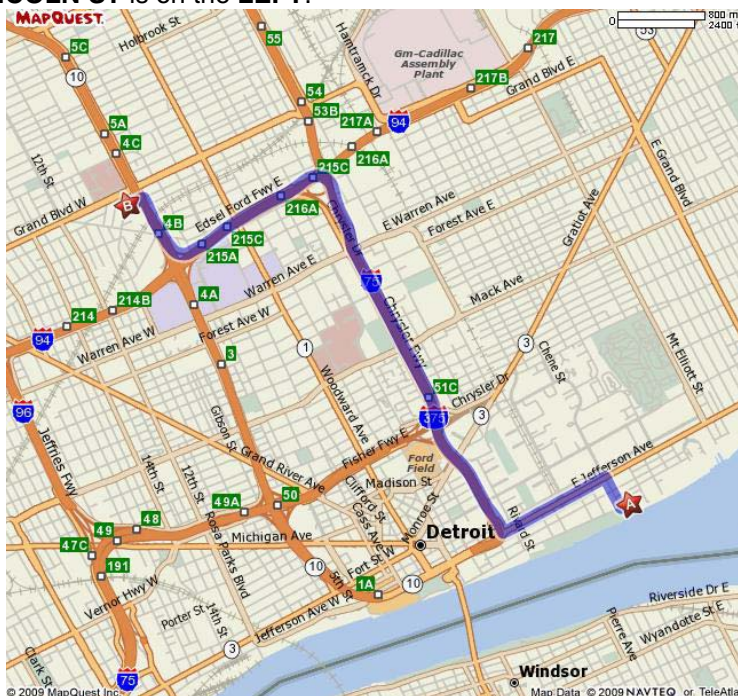
Henry Ford Hospital (Emergency Room)
6503 Lincoln St.
Detroit, Michigan 48202
(313)-874-2839

FIGURE 2-2
HOSPITAL ROUTE

Total Travel Estimates: 10 minutes / 5.46 miles

A: 2660 Atwater St, Detroit, MI 48207-4418

- | | | |
|-----|--|--------|
| 1: | Start out going SOUTHWEST on E ATWATER ST toward CHENE ST. | 0.1 mi |
| 2: | Turn RIGHT onto CHENE ST. | 0.2 mi |
| 3: | Turn LEFT onto E JEFFERSON AVE/JEFFERSON AVE E. | 0.8 mi |
| 4: | Turn RIGHT onto CHRYSLER DR. | 0.1 mi |
| 5: | Turn SLIGHT LEFT onto ramp. | 0.1 mi |
| 6: | Merge onto I-375 N/CHRYSLER FWY. | 0.6 mi |
| 7: | I-375 N/CHRYSLER FWY becomes I-75 N/CHRYSLER FWY. | 1.4 mi |
| 8: | Take EXIT 53B toward I-94/FORD FWY/PORT HURON/CHICAGO. | 0.4 mi |
| 9: | Merge onto I-94 W via the exit on the LEFT toward CHICAGO. | 1.0 mi |
| 10: | Take the M-10 N exit, EXIT 215B , toward SOUTHFIELD. | 0.3 mi |
| 11: | Merge onto MI-10 N/JOHN C LODGE FWY. | 0.2 mi |
| 12: | Take the MILWAUKEE AVE exit, EXIT 4C , toward W GRAND BLVD. | 0.2 mi |
| 13: | Turn LEFT onto MILWAUKEE ST W. | 0.1 mi |
| 14: | Turn RIGHT onto LINCOLN ST. | 0.0 mi |
| 15: | 6503 LINCOLN ST is on the LEFT. | 0.0 mi |



2.9 INJURY AND ILLNESS REPORTING

Any pertinent information regarding allergies to medications or other special conditions will be provided to medical service personnel. This information is listed on Medical Data Sheets (see Attachment II) filed onsite. If an exposure to hazardous materials has occurred, provide hazard information from Table 6-1 to medical service personnel. As soon as possible, the USCG contact must be informed of any incident or accident that requires medical attention.

2.9.1 TOTAL Incident Reporting System

TOTAL is Tetra Tech's new online incident reporting system. Use TOTAL to directly report health and safety incidents, notify key personnel, and initiate the process for properly investigating and addressing the causes of incidents, including near-miss events. An incident is considered any unplanned event. It may include several types of near misses, events where no loss was incurred, or incidents that resulted in injuries or illness, property or equipment damage, chemical spills, fires, or damage to motor vehicles.

TOTAL looks like the incident reporting form in Attachment I. TOTAL is an intuitive system that will guide you through the necessary steps to report an incident within 24 hours of its occurrence. Behind the scenes, TOTAL is a powerful tool for H&S professionals, and will help Tetra Tech to better track incidents, analyze root causes, implement corrective action plans, and share lessons learned. The ultimate result is a more safe and healthy working environment for us all.

TOTAL is maintained on the Tetra Tech Intranet site at <https://my.tetrattech.com/>

Once on the "My Tetrattech" site, TOTAL can be found under the Health and Safety tab, Incident Reporting section, select "Report an Incident (TOTAL)". This will connect you directly to TOTAL. TOTAL can also be accessed directly from the internet using the following web address: <http://totalhs.tetrattech.com/>

Note: When using the system outside the Tetra Tech intranet system or when operating in a wireless mode, a VPN connection will be required. The speed of the application may be affected dependent upon outside factors such as connection, signal strength, etc. Enter the system using your network user name and password. The user name should be in the following format - TT\nickname.lastname.

2.10 PPE AND EMERGENCY EQUIPMENT

First-aid kits, eye wash units (or bottles of disposable eyewash solution) and fire extinguishers will be maintained onsite and shall be immediately available for use in the event of an emergency. This

equipment will be located in the field office or site vehicles. Personnel will only provide first-aid assistance to the level of their training.

3.0 SITE BACKGROUND

The Site is located within the USCG property at 2660 East Atwater Street in Detroit, Michigan. The Site consists of two structures on approximately 1.26 acres of harbor front land in downtown Detroit, Michigan. A maintenance building and a six-car garage are located on the site. The site vicinity is predominately commercial/industrial. Property to the east is a parking lot for a boat dock/touring service, to the west is a bulk aggregate facility with three large silos, to the south is the Detroit River, and to the north is Atwater Street.

4.0 SCOPE OF WORK

This section of the HASP identifies the planned site activities that are to be conducted as part of the field activities. Tasks that will be performed at this site are:

- Mobilization/demobilization
- Soil boring/sampling via direct push technology (DPT)
 - Tetra Tech NUS is implementing a field sampling activity and will be soil sampling by DPT at 15 locations. At all locations, samples will be collected for analysis at 1 to 2 feet and 4 to 5 feet. At 4 locations, the boring will be advanced to about 15 feet, then left open overnight to monitor groundwater flow.
- Monitoring well installation (shallow, hollow stem auger and PVC)
 - Including groundwater sampling
- Decontamination of heavy and sampling equipment
- IDW management

Any additionally tasks not identified above will be considered a change in scope requiring modification of this document. Requested modifications to this document will be submitted to the HSM by the PM or a designated representative.

5.0 IDENTIFYING AND COMMUNICATING TASK-SPECIFIC HAZARDS AND SAFE WORK PRACTICES

The purpose of this section is to identify the anticipated hazards and appropriate hazard prevention/hazard control measures that are to be observed for each planned task or operation. These topics have been summarized for each planned task through the use of task-specific Safe Work Permits (SWPs), which are to be reviewed in the field by the SSO with all task participants prior to initiating any task. Additionally, potential hazard and hazard control matters that are relevant but are not necessarily task-specific are addressed in the following portions of this section.

Section 6.0 presents additional information on hazard anticipation, recognition, and control relevant to the planned field activities.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices and restrictions identified in the SWPs attached to this HASP, the following general safe work practices are to be followed when conducting work on-site.

- Eating, drinking, chewing gum or tobacco, taking medication, or smoking in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists is prohibited.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. If a source of potable water is not available at the work site that can be used for hands-washing, the use of waterless hands cleaning products will be used, followed by actual hands-washing as soon as practicable upon exiting the site.
- Avoid contact with potentially contaminated substances including puddles, pools, mud, or other such areas. Avoid, kneeling on the ground or leaning or sitting on equipment. Keep monitoring equipment away from potentially contaminated surfaces.
- Plan and mark entrance, exit, and emergency evacuation routes.
- Rehearse unfamiliar operations prior to implementation.
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity to assist each other in case of emergency.

- Establish appropriate safety zones including support, contamination reduction, and exclusion zones.
- Minimize the number of personnel and equipment in contaminated areas (such as the exclusion zone). Non-essential vehicles and equipment should remain within the support zone.
- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the SSO.
- Observe co-workers for signs of toxic exposure and heat or cold stress.
- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

5.2 DPT SAFE WORK PRACTICES

The following Safe Work Practices are to be followed when working in or around the DPT Operations (HSGM, Section 7.0).

- Identify underground utilities and buried structures before commencing any DPT operations. Follow the Tetra Tech Utility Locating and Excavation Clearance Standard Operating Procedure.
- DPT rigs will be inspected by the SSO or designee, prior to the acceptance of the equipment at the site and prior to the use of the equipment. Repairs or deficiencies identified will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist for DPT rigs provided in Attachment III. After the initial inspection and release for use on site, additional inspections will be performed at least at the beginning of every 5 or 10-day shift, or following any repairs or significant maintenance activities.
- Ensure that all machine guarding is in place and properly adjusted.
- Block the DPT rig and use levelers to prevent inadvertent movement.
- The work area around the point of operation will be cleared to the extent possible to remove any trip hazards near or surrounding operating equipment.

- The driller's helper will establish an equipment staging and laydown plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards. Mechanisms to secure heavy objects such as DPT flights will be provided to avoid the collapse of stacked equipment.
- Minimize contact to the extent possible with contaminated tooling and environmental media. Potentially contaminated tooling will be placed on polyethylene sheeting for storage and wrapped for transport to the centrally located equipment decontamination area
- Support functions (sampling and screening stations) will be maintained a minimum distance from the DPT rig of the height of the mast plus five feet, but not less than 25 feet around the rig.
- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the DPT rig.
- During maintenance, use only manufacturer provided/approved equipment (i.e. auger flight connectors, etc.)
- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should be used to move auger flights and other heavy tooling.
- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone.
- Equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the FOL and/or the SSO to determine cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.
- Motorized equipment will be fueled prior to the commencement of the day's activities.
- When not in use DPT rig will be shutdown, and emergency brakes set and wheels will be chocked to prevent movement.
- DPT Rig will have an operational Emergency Stop and one employee will be assigned to operate it during rig operations.

Investigative areas will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be immediately removed, the area will be barricaded to limit access.

5.3 HOLLOW STEM AUGER/ROTARY DRILLING SAFE WORK PRACTICES

The following Safe Work Practices are to be followed when working in or around the Rotary Drilling Operations.

- Identify underground utilities and buried structures before commencing any operations.
- Follow the Tetra Tech Utility Locating and Excavation Clearance Standard Operating Procedure found in Section 7.0 of the Health and Safety Guidance Manual.
- Drill rigs will be inspected by the SSO or designee, prior to the acceptance of the equipment at the site and prior to the use of the equipment.
- Repairs or deficiencies identified will be corrected prior to use.
- The inspection will be accomplished using the Equipment Inspection Checklist for drill rigs provided in Attachment III.
- After the initial inspection and release for use on site, additional inspections will be performed at least at the beginning of every 5 or 10-day shift, or following any repairs or significant maintenance activities.
- Prior to the start of boring operations, one individual will be designated as the person responsible for immediate activation of the emergency stop device in the event of an emergency.
- This individual will be identified to the field crew and will be responsible for visually checking the work area and verbally alerting personnel in the vicinity of boring operations prior to engaging the equipment.
- Ensure that all machine guarding is in place and properly adjusted.
- Block the drill rig and use levelers to prevent inadvertent movement.
- The work area around the point of operation will be cleared to the extent possible to remove any trip hazards near or surrounding operating equipment.
- The driller's helper will establish an equipment staging and laydown plan.

- The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards.
- Mechanisms to secure heavy objects such as drill flights will be provided to avoid the collapse of stacked equipment.
- Minimize contact to the extent possible with contaminated tooling and environmental media.
- Potentially contaminated tools will be placed on polyethylene sheeting for storage and wrapped for transport to the centrally located equipment decontamination area.
- Support functions (sampling and screening stations) will be maintained a minimum distance from the drill rig of the height of the mast plus five feet , but not less than 25 feet around the rig.
- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the drill rig.
- During maintenance, use only manufacturer provided/approved equipment (i.e. auger flight connectors, etc.)
- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should be used to move auger flights and other heavy tooling.
- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone.
- Equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the FOL and/or the SHSO to determine cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.
- Motorized equipment will be fueled prior to the commencement of the day's activities.
- When not in use drill rig will be shutdown, and emergency brakes set and wheels will be chocked to prevent movement.
- Investigative areas will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards.

5.3.1 **Before Drilling**

- Identify underground utilities, buried structures, and aboveground utility lines before drilling. Tetra Tech NUS, Inc. personnel will use the Utility Locating and Excavation Clearance Standard Operating Procedure provided in the Tetra Tech Health and Safety Guidance Manual.
- Drill rigs will be inspected by the SSO or designee, prior to the acceptance of the equipment at the site and prior to the use of the equipment. Needed repairs or identified deficiencies will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist provided in Attachment IV. Additional inspections will be performed at least once every 10-day shift or following repairs.
- Check operation of the Emergency Stop/Kill Switch and/or the "Dead Man's" operational controls. These operational checks are required initially as part of the equipment pre-use inspection, and then periodically thereafter. Periodic checks are required at least weekly, or more frequently if recommended by the rig manufacturer.
- Ensure that machine guarding is in place and properly adjusted.
- Block drill rig and use out riggers/levelers to prevent movement of the rig during operations.
- The work area around the point of operation will be graded to the extent possible to remove any trip hazards near or surrounding operating equipment.
- The driller's helper will establish an equipment staging and lay down plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards. Mechanisms to secure heavy objects such as drill flights will be provided to avoid the collapse of stacked equipment.
- Potentially contaminated tooling will be wrapped in polyethylene sheeting for storage and transport to the centrally located equipment decontamination unit.
- Prior to each instance of engaging the drill rig, the Driller will look to ensure that the drilling area is clear of personnel and obstructions, and verbally alert everyone in the area that the rig is about to be engaged.
- Prior to the start of boring operations, one individual will be designated as the person responsible for immediate activation of the emergency stop device (if applicable) in the event of an emergency. This

individual will be made known to the field crew and will be responsible for visually checking the work area and verbally alerting everyone of boring operations prior to engaging the equipment.

5.3.2 During Drilling

- The Driller will ensure that an individual is constantly stationed at a location where the drill rig emergency stop switch can be immediately engaged.
- Minimize contact to the extent possible with contaminated tooling and environmental media.
- Support functions (sampling and screening stations) will be maintained a minimum distance from the drill rig of the height of the mast plus five feet or 35-feet for drill rig, whichever is greater to remove these activities from within physical hazard boundaries.
- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the drill rig.
- During maintenance, use only manufacturer provided/approved equipment (i.e. auger flight connectors, etc.)
- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should move auger flights and other heavy tooling.
- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone.

5.3.3 After Drilling

- Equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the SSO to determine cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.
- Motorized equipment will be fueled prior to the commencement of the day's activities. During fueling operations equipment will be shutdown and bonded to the fuel source.
- When not in use drill rigs will be shutdown, and emergency brakes set and wheels will be chocked to prevent movement.

- The mast will be completely lowered and outrigger completely retracted during movement to decontamination or the next location.
- Areas subjected to subsurface investigative methods will be restored to equal or better than original condition. Any contamination that was brought to the surface by HSA drilling will be removed and containerized. Physical hazards (debris, uneven surfaces, ruts, etc.) will be removed, repaired or otherwise corrected. In situations where these hazards cannot be removed these areas will be barricaded to minimize the impact on field crews working in the area.

6.0 HAZARD ASSESSMENT AND CONTROLS

This section provides information regarding the chemical and physical hazards which may be associated with the Site and the activities that are to be conducted as part of the scope of work.

6.1 CHEMICAL HAZARDS

Based upon available data from previous site investigations, the primary site contaminants of concern (COCs) are PAHs and metals. However, from a worst-case scenario, none of the COCs are likely to reach concentrations that would potentially exceed current Occupational Exposure Limits (OELs). In addition, the amount of dust-in-air that would have to be generated to reach current OELs is well within the spectrum visible to the naked eye. Therefore, area wetting techniques will be used, when necessary, to suppress dust generation.

6.1.1 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat. PAHs are usually found as a mixture containing two or more of these compounds, such as soot.

Some PAHs are manufactured. These pure PAHs usually exist as colorless, white, or pale yellow-green solids. PAHs are found in coal tar, crude oil, creosote, and roofing tar, but a few are used in medicines or to make dyes, plastics, and pesticides.

Exposure to polycyclic aromatic hydrocarbons usually occurs by breathing air contaminated by wild fires or coal tar, or by eating foods that have been grilled. PAHs have been found in at least 600 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency.

PAHs have the potential to cause harmful effects on the skin, body fluids, and ability to fight disease after both short- and long-term exposure.

6.1.2 Metals

There are 35 metals that concern us because of occupational or residential exposure; 23 of these are the heavy elements or "heavy metals. Heavy metal toxicity can result in damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidneys, liver, and other vital organs.

For some heavy metals, toxic levels can be just above the background concentrations naturally found in nature. Therefore, it is important for us to inform ourselves about the heavy metals and to take protective measures against excessive exposure.

Symptoms indicative of acute metal toxicity are: cramping, nausea, and vomiting; pain; sweating; headaches; difficulty breathing; impaired cognitive, motor, and language skills; and mania and convulsions.

6.1.3 Inhalation

From a worst-case scenario, benzene immediately above a captured air phase above contaminated media (such as in the head space of a monitoring well) could reach concentrations that exceed permissible limits. However, it is important to recognize the following:

- the planned work area is outdoors, with ample natural ventilation that will reduce any airborne VOCs through dilution and dispersion, and
- the concentrations used in this evaluation were the highest concentrations detected.

As a result of these factors, it is very unlikely that workers participating in this activity will encounter any airborne concentrations of VOC/SVOCs that would represent an inhalation exposure concern.

6.1.4 Ingestion and Skin Contact

Potential exposure concerns to COCs may also occur through ingesting or coming into direct skin contact with contaminated media. The likelihood of worker exposure concerns through these two routes are also considered very unlikely, provided that workers follow good personal hygiene and standard good sample collection/sample handling practices, and wear appropriate PPE as specified in this HASP. Examples onsite practices that are to be observed that will protect workers from exposure via ingestion or skin contact include the following:

- No hand-to-mouth activities on site (eating, drinking, smoking, etc.)
- Washing hands upon leaving the work area and prior to performing any hand to mouth activities
- Wearing surgeon's-style gloves whenever handling potentially-contaminated media, including groundwater, bailing tools, and sample containers.

6.2 PHYSICAL HAZARDS

The following is a list of physical hazards that may be encountered at the site or may be present during the performance of site activities.

- Slip, trips, and falls
- Strain/muscle pulls from heavy lifting
- Heat/Cold stress
- Pinch/compression points
- Natural hazards (snakes, ticks, poisonous plants, etc.)
- Vehicular and equipment traffic
- Inclement weather

These hazards are discussed further below, and are presented relative to each task in the task-specific Safe Work Permits.

6.2.1 Slips, Trips, and Falls

During various site activities there is a potential for slip, trip, and fall hazards associated with wet, steep, or unstable work surfaces. To minimize hazards of this nature, personnel required to work in and along areas prone to these types of hazards will be required to exercise caution, and use appropriate precautions (restrict access, guardrails, life lines and/or safety harnesses) and other means suitable for the task at hand. Site activities will be performed using the buddy system.

6.2.2 Strain/Muscle Pulls from Heavy Lifting

During execution of planned activities there is some potential for strains, sprains, and/or muscle pulls due to the physical demands and nature of this site work. To avoid injury during lifting tasks personnel are to lift with the force of the load carried by their legs and not their backs. When lifting or handling heavy material or equipment use an appropriate number of personnel. Keep the work area free from ground clutter to avoid unnecessary twisting or sudden movements while handling loads.

6.2.3 Heat/Cold Stress

It is always necessary for the field team to be aware of the signs and symptoms and the measures appropriate to prevent heat and cold stress. This is addressed in detail in Section 4.0 of the Tetra Tech Health and Safety Guidance Manual, which the SSO is responsible for reviewing and implementing as appropriate on this project.

6.2.4 Pinch/Compression Points

Handling of tools, machinery, and other equipment on site may expose personnel to pinch/compression point hazards during normal work activities. Where applicable, equipment will have intact and functional guarding to prevent personnel contact with hazards. Personnel will exercise caution when working around pinch/compression points, using additional tools or devices (e.g., pinch bars) to assist in completing activities.

6.2.5 Vehicular and Equipment Traffic

Hazards associated with vehicular and equipment traffic are unlikely to exist during site activities. To minimize the potential for injuries associated with potential vehicular hazards, site personnel will be instructed to maintain awareness of traffic and moving equipment when performing site activities. When working near roadways, site personnel will wear high visibility vests.

6.2.6 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather (electrical storms, hurricane, tornadoes, etc.) conditions arise, the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

6.3 NATURAL HAZARDS

Natural hazards such as poisonous plants, bites from poisonous or disease carrying animals or insects (e.g., snakes, ticks, mosquitoes) are often prevalent at sites that are being investigated as part of hazardous waste site operations. To minimize the potential for site personnel to encounter these hazards, nesting areas in and about work areas will be avoided to the greatest extent possible. Work areas will be inspected to look for any evidence that dangerous animals may be present. In general, avoidance of areas of known infestation of insects or growth of poisonous plants will be the preferred exposure control.

6.3.1 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors and near water. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, hurricanes, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

7.0 AIR MONITORING

The primary COCs do not have the potential to be present in concentrations that could present an inhalation hazard during planned site activities. Therefore, it is not necessary to implement direct reading instruments for these activities.

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

This section specifies health and safety training and medical surveillance requirements for both Tetra Tech and subcontractor personnel participating in on-site activities.

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section is included to specify health and safety training and medical surveillance requirements for Tetra Tech personnel participating in on site activities. Tetra Tech personnel must complete 40 hours of introductory hazardous waste site training prior to performing work Detroit Atwater. Tetra Tech personnel who have had introductory training more than 12 months prior to site work must have completed 8 hours of refresher training within the past 12 months before being cleared for site work. In addition, 8-hour supervisory training in accordance with 29 CFR 1910.120(e)(4) will be required for site supervisory personnel.

Documentation of Tetra Tech introductory, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

8.2 SITE-SPECIFIC TRAINING

Tetra Tech SSO will provide site-specific training to Tetra Tech employees who will perform work on this project. Figure 8-1 will be used to document the provision and content of the project-specific and associated training. Site personnel will be required to sign this form prior to commencement of site activities. This training documentation will be employed to identify personnel who through record review and attendance of the site-specific training are cleared for participation in site activities. This document shall be maintained at the site to identify and maintain an active list of trained and cleared site personnel.

The Tetra Tech SSO will also conduct a pre-activities training session prior to initiating site work. This will consist of a brief meeting at the beginning of each day to discuss operations planned for that day, and a review of the appropriate Safe Work Permits with the planned task participants. A short meeting may also be held at the end of the day to discuss the operations completed and any problems encountered.

8.3 MEDICAL SURVEILLANCE

Tetra Tech personnel participating in project field activities will have had a physical examination meeting the requirements of Tetra Tech's medical surveillance program. Documentation for medical clearances

will be maintained in the Tetra Tech Pittsburgh office and made available, as necessary, and will be documented using Figure 8-1 for every employee participating in onsite work activities at this site.

Each field team member, including visitors, entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet (see Attachment II of this HASP). This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

FIGURE 8-1
SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing monitoring well inventory/abandonment and sign replacement activities at Detroit Atwater and that I have received site-specific training that included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of personal protective equipment
- Work practices to minimize risks from hazards
- Safe use of engineering controls and equipment
- Medical surveillance requirements
- Signs and symptoms of overexposure
- Emergency response procedures (evacuation and assembly points)
- Spill response procedures
- Review of contents of relevant Material Safety Data Sheets
- Stop Work Procedures

I have been given the opportunity to ask questions and my questions have been answered to my satisfaction. The dates of my training and medical surveillance indicated below are accurate.

[illegible]

9.0 SITE CONTROL

This section outlines the means by which Tetra Tech will delineate work zones and use these work zones in conjunction with decontamination procedures to prevent the spread of contaminants into previously unaffected areas of the site. It is anticipated that a fractured three-zone approach will be used during work at this site. This three zone approach will utilize an exclusion zone, a contamination reduction zone, and a support zone. It is also anticipated that this control measure will be used to control access to site work areas. Use of such controls will restrict the general public, minimize the potential for the spread of contaminants, and protect individuals who are not cleared to enter work areas.

9.1 EXCLUSION ZONE

The exclusion zone will be considered the areas of the site of known or suspected contamination. It is anticipated that the areas around intrusive field activities will have the potential for contaminants to be brought to the surface. These areas will be marked and personnel will maintain safe distances. Once intrusive field activities have been completed and any surface contamination has been removed, the potential for exposure is again diminished and the area can then be reclassified as part of the contamination reduction zone. Therefore, the exclusion zones for this project will be limited to those areas of the site where intrusive field activities are being performed plus a designated area of at least 15 feet surrounding the work area. Exclusion zones will be delineated as deemed appropriate by the FOL, through means such as erecting visibility fencing, barrier tape, cones, and/or postings to inform and direct personnel.

9.1.1 Exclusion Zone Clearance

A pre-startup site visit will be conducted by members of the identified field team in an effort to identify proposed subsurface investigation locations, conduct utility clearances, and provide upfront notices concerning scheduled activities within the facility.

Subsurface activities will proceed only when utility clearance has been obtained. In the event that a utility is struck during a subsurface investigative activity, the emergency numbers provided in Section 2.0, Table 2-1, will be notified.

9.2 CONTAMINATION REDUCTION ZONE

The contamination reduction zone (CRZ) will be a buffer area between the exclusion zone and any area of the site where contamination is not suspected. This area will also serve as a focal point in supporting exclusion zone activities. This area will be delineated using barrier tape, cones, and postings to inform

and direct facility personnel. Decontamination will be conducted at a central location. Equipment potentially contaminated will be bagged and taken to that location for decontamination.

9.3 SUPPORT ZONE

The support zone for this project will include a staging area where site vehicles will be parked, equipment will be unloaded, and where food and drink containers will be maintained. The support zones will be established at areas of the site where exposure to site contaminants would not be expected during normal working conditions or foreseeable emergencies.

9.4 SAFE WORK PERMITS

Exclusion Zone work conducted in support of this project will be performed using Safe Work Permits (SWPs) to guide and direct field crews on a task by task basis. An example of the SWP to be used is provided in Figure 9-1. Partially completed SWPs for the work to be performed are attached to this HASP (Attachment V). These permits were completed to the extent possible as part of the development of this HASP. It is the SSO's responsibility to finalize and complete all blank portions of the SWPs based on current, existing conditions the day the task is to be performed, and then review that completed permit with all task participants as part of a pre-task tail gate briefing session. This will ensure that site-specific considerations and changing conditions are appropriately incorporated into the SWP, provide the SSO with a structured format for conducting the tail gate sessions, as well will also give personnel an opportunity to ask questions and make suggestions. All SWPs require the signature of the FOL or SSO.

Personnel identified on the permit as participating in the task will be made aware of its contents by the supervisor accepting the permit. Any problems which occurred throughout the task will be documented by the supervisor on the permit.

Permits will be returned to the FOL or the SSO at the end of the day.

9.5 SITE VISITORS

Site visitors must be escorted and restricted from approaching any work areas where they could be exposed to hazards from Tetra Tech operations. If a visitor has authorization from the client and from the Tetra Tech Project Manager to approach our work areas, the FOL must assure that the visitor first provides documentation indicating that he/she/they have successfully completed the necessary OSHA introductory training, receive site-specific training from the SSO, and that they have been physically cleared to work on hazardous waste sites.

FIGURE 9-1
SAFE WORK PERMIT

Permit No. _____ Date: _____ Time: From _____ to _____

I. Work limited to the following (description, area, equipment used): _____

II. Primary Hazards: _____

III. Field Crew: _____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech

V. Protective equipment required

Level D ☐ Level B ☐
 Level C ☐ Level A ☐

Modifications/Exceptions: _____

Respiratory equipment required

Yes ☐ Specify on the reverse
 No ☐

VI. Chemicals of Concern	Hazard Monitoring	Action Level(s)	Response Measures
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Primary Route(s) of Exposure/Hazard: _____

(Note to FOL and/or SSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. Additional Safety Equipment/Procedures

Hard-hat..... ☐ Yes ☐ No
 Safety Glasses ☐ Yes ☐ No
 Chemical/splash goggles ☐ Yes ☐ No
 Splash Shield..... ☐ Yes ☐ No
 Splash suits/coveralls ☐ Yes ☐ No
 Impermeable apron..... ☐ Yes ☐ No
 Steel toe work shoes or boots.... ☐ Yes ☐ No
 High Visibility vest..... ☐ Yes ☐ No
 First Aid Kit ☐ Yes ☐ No
 Safety Shower/Eyewash ☐ Yes ☐ No

Modifications/Exceptions: _____

Hearing Protection (Plugs/Muffs) ☐ Yes ☐ No
 Safety belt/harness ☐ Yes ☐ No
 Radio/Cellular Phone..... ☐ Yes ☐ No
 Barricades ☐ Yes ☐ No
 Gloves (Type – Work) ☐ Yes ☐ No
 Work/rest regimen ☐ Yes ☐ No
 Chemical Resistant Boot Covers ☐ Yes ☐ No
 Tape up/use insect repellent ☐ Yes ☐ No
 Fire Extinguisher..... ☐ Yes ☐ No
 Other..... ☐ Yes ☐ No

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical Hazards Identified and Isolated (Splash and containment barriers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IX. Additional Permits required (Hot work, confined space entry, excavation etc.)..... ☐ Yes ☐ No
If yes, SSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. Special instructions, precautions: _____

Permit Issued by: _____ Permit Accepted by: _____

Site visitors for the purpose of this document are identified as representing the following groups of individuals:

- Personnel invited to observe or participate in operations by Tetra Tech
- Regulatory personnel (i.e., DOD, EPA, OSHA, etc.)
- Other authorized visitors

Non-DOD personnel working on this project are required to gain initial access to the base by coordinating with the Tetra Tech FOL or designee and following established base access procedures.

Once access to the site is obtained, personnel who require site access into areas of ongoing operations will be required to obtain permission from the FOL and the site contact. Upon gaining access to the site, site visitors wishing to observe operations in progress will be escorted by Tetra Tech representative and shall be required to meet the minimum requirements discussed below:

- Site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individual's name (proper identification required), the entity which they represent, and the purpose of the visit.

Once the site visitors have completed the above items, they will be permitted to enter the operational zone. Visitors are required to observe the protective equipment and site restrictions in effect at the site at the time of their visit. Visitors entering the exclusion zones during ongoing operations will be accompanied by a Tetra Tech representative. Visitors not meeting the requirements, as stipulated in this plan, for site clearance will not be permitted to enter the site operational zones during planned activities.

9.6 SITE SECURITY

Site security will be accomplished using Tetra Tech field personnel. Tetra Tech will retain complete control over active operational areas. As this activity takes place at a facility open to public access, the first line of security will take place using exclusive zone barriers, site work permits, and any existing barriers at the sites to restrict the general public. The second line of security will take place at the work site referring interested parties to the site contact. The site contact will serve as a focal point for base personnel, interested parties, and serve as the final line of security and the primary enforcement contact.

9.7 BUDDY SYSTEM

Personnel engaged in site activities will practice the "buddy system" to ensure the safety of the personnel involved in this operation.

9.8 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

Tetra Tech and subcontractor personnel will provide MSDSs for the chemicals brought on site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application of the substances on site. A chemical inventory of the chemicals used on site will be developed using the Health and Safety Guidance Manual. The MSDSs will then be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request.

9.9 COMMUNICATION

As personnel will be working in proximity to one another during field activities, a supported means of communication between field crew members will not be necessary.

External communication will be accomplished by using cell phone or telephones at predetermined and approved locations. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of activities at Detroit Atwater, the FOL will determine and arrange for telephone communications.

10.0 SPILL CONTAINMENT PROGRAM

10.1 SCOPE AND APPLICATION

It is anticipated that quantities of bulk potentially hazardous materials (greater than 55-gallons) will not be handled during the site activities. It is possible, however, that as the job progresses disposable PPE and other non-reusable items may be generated. As needed, 55-gallon drums will be used to contain unwanted items generated during sampling activities. The drum(s) will be labeled with the site name and address, the type of contents, and the date the container was filled as well as an identified contact person. As warranted, samples will be collected and analyzed to characterize the material and determine appropriate disposal measures. Once characterized the drum(s) will be removed from the staging area and disposed of in accordance with Federal, State and local regulations. Given the likely solid nature of drum contents, a comprehensive Spill Containment Program is not necessary. The following discussion is provided as contingency information only.

10.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

It is anticipated that the IDW generated as a result of this scope of work will be containerized, labeled, and staged to await further analyses. The results of these analyses will determine the method of disposal.

10.3 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, periodic inspections by the SSO will be conducted during working hours to visually determine that containers are not leaking. If a leak is detected, the first approach will be to transfer the container contents using a hand pump into a new container. Other provisions for the transfer of container contents will be made and appropriate emergency contacts will be notified, if necessary. In most instances, leaks will be collected and contained using absorbents such as Oil-dry, vermiculite, and/or sand, which may be stored at the staging area in a

conspicuously marked drum. This material too, will be containerized for disposal pending analyses. Inspections will be documented in the Project Logbook.

10.4 PERSONNEL TRAINING AND SPILL PREVENTION

Site personnel will be instructed on the procedures for spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinator for this operation should the need arise.

10.5 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the types of equipment that may be maintained at the staging area for the purpose of supporting this Spill Containment Program (depending on the likelihood that drums and/or liquid wastes are generated):

- Sand, clean fill, vermiculite, or other noncombustible absorbent (oil-dry);
- Drums (55-gallon U.S. DOT 1A1 or 1A2)
- Shovels, rakes, and brooms
- Labels

10.6 SPILL CONTROL PLAN

This section describes the procedures the Tetra Tech field crewmembers will employ upon the detection of a spill or leak.

- Notify the SSO or FOL immediately.
- Take immediate actions to stop the leak or spill by plugging or patching the drum or raising the leak to the highest point. Avoid contacting drum contents. Spread the absorbent material in the area of the spill covering completely.

It is not anticipated that a spill will occur in which the field crews cannot handle. Should this occur; however, the FOL or SSO will notify appropriate emergency response agencies.

11.0 CONFINED-SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces.** A confined space is defined as an area which has one or more of the following characteristics:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is one that:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed.

12.0 MATERIALS AND DOCUMENTATION

The Tetra Tech Field Operations Leader (FOL) shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailer)
- Training/Medical Surveillance Documentation Form (Blank)
- First-Aid Supply Usage Form
- Emergency Reference Form (Section 2.0, extra copy for posting)
- Directions to the Hospital

12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents the chemicals brought on-site, including decontamination solutions, sample preservations, fuel, etc.. This list should be posted in a central area.

Material Safety Data Sheets (MSDS) (maintained) - The MSDSs should also be in a central area accessible to the site personnel. These documents should match the listings on the chemical inventory list for the substances employed on-site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster (posted) - this poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaces, altered, or covered by other material.

Site Clearance (maintained) - This list is found within the training section of the HASP (See Figure 8-2). It identifies site personnel, dates of training (including site-specific training), and medical surveillance. It

also indicates clearance as well as status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) (posted) - This list of numbers and directions will be maintained at the phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be filled out by on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility.

Hearing Conservation Standard (29 CFR 1910.95) (posted) - this standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring (maintained) - The results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using DOT placards and acceptable (Hazard Communication 29 CFR 1910.1200(f)) labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable, providing the objection is accomplished.

13.0 ACRONYMS / ABBREVIATIONS

CFR	Code of Federal Regulations
CIH	Certified Industrial Hygienist
CRZ	Contamination Reduction Zone
CSP	Certified Safety Professional
dBA	Decibel
DOD	Department of Defense
DOT	Department of Transportation
DPT	Direct Push Technology
EPA	Environmental Protection Agency
FOL	Field Operations Leader
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
IDW	Investigation Derived Waste
mg/kg	milligrams per kilogram
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PHSO	Project Health and Safety Officer
PM	Project Manager
PPE	Personal Protective Equipment
SSO	Site Safety Officer
SVOCs	Semi-Volatile Organic Compounds
TBD	To be determined
Tetra Tech	Tetra Tech NUS
USCG	United States Coast Guard
VOCs	Volatile Organic Compounds

ATTACHMENT I
INCIDENT REPORT FORM

Report Date	Report Prepared By	Incident Report Number
<p align="center">INSTRUCTIONS:</p> <p>All incidents (including those involving subcontractors under direct supervision of Tetra Tech personnel) must be documented on the IR Form.</p> <p>Complete any additional parts to this form as indicated below for the type of incident selected.</p>		
TYPE OF INCIDENT (Check all that apply)		Additional Form(s) Required for this type of incident
Near Miss (No losses, but could have resulted in injury, illness, or damage)	<input type="checkbox"/>	Complete IR Form Only
Injury or Illness	<input type="checkbox"/>	Complete Form IR-A; Injury or Illness
Property or Equipment Damage, Fire, Spill or Release	<input type="checkbox"/>	Complete Form IR-B; Damage, Fire, Spill or Release
Motor Vehicle	<input type="checkbox"/>	Complete Form IR-C; Motor Vehicle
INFORMATION ABOUT THE INCIDENT		
Description of Incident		
<div></div> <div></div> <div></div>		
Date of Incident	Time of Incident	
	<div></div> AM <input type="checkbox"/> PM <input type="checkbox"/> OR Cannot be determined <input type="checkbox"/>	
Weather conditions at the time of the incident	Was there adequate lighting?	
	<div></div> Yes <input type="checkbox"/> No <input type="checkbox"/>	
Location of Incident		
<div></div> Was location of incident within the employer's work environment? Yes <input type="checkbox"/> No <input type="checkbox"/>		
Street Address	City, State, Zip Code and Country	
Project Name/Number	Client:	
Tt Supervisor or Project Manager	Was supervisor on the scene?	
	<div></div> Yes <input type="checkbox"/> No <input type="checkbox"/>	
WITNESS INFORMATION (attach additional sheets if necessary)		
Name	Company	
Street Address	City, State and Zip Code	
Telephone Number(s)		

CORRECTIVE ACTIONS				
Corrective action(s) immediately taken by unit reporting the incident:				
Corrective action(s) still to be taken (by whom and when):				
ROOT CAUSE ANALYSIS LEVEL REQUIRED				
Root Cause Analysis Level Required: Level - 1 <input type="checkbox"/> Level - 2 <input type="checkbox"/> None <input type="checkbox"/>				
Root Cause Analysis Level Definitions				
Level - 1	<p>Definition: A Level 1 RCA is conducted by an individual(s) with experience or training in root cause analysis techniques and will conduct or direct documentation reviews, site investigation, witness and affected employee interviews, and identify corrective actions. Activating a Level 1 RCA and identifying RCA team members will be at the discretion of the Corporate Administration office.</p> <p>The following events may trigger a Level 1 RCA:</p> <ul style="list-style-type: none"> Work related fatality Hospitalization of one or more employee where injuries result in total or partial permanent disability Property damage in excess of \$75,000 When requested by senior management 			
Level - 2	<p>Definition: A Level 2 RCA is self performed within the operating unit by supervisory personnel with assistance of the operating unit HSR. Level 2 RCA will utilize the 5 Why RCA methodology and document the findings on the tools provided.</p> <p>The following events will require a Level 2 RCA:</p> <ul style="list-style-type: none"> OSHA recordable lost time incident Near miss incident that could have triggered a Level 1 RCA When requested by senior management 			
Complete the Root Cause Analysis Worksheet and Corrective Action form. Identify a corrective action(s) for each root cause identified within each area of inquiry.				
NOTIFICATIONS				
Title	Printed Name	Signature	Telephone Number	Date
Project Manager or Supervisor				
Site Safety Coordinator or Office H&S Representative				
Operating Unit H&S Representative				
Other: _____				

The signatures provided above indicate that appropriate personnel have been notified of the incident.

INSTRUCTIONS:

Complete all sections below for incidents involving injury or illness.
Do NOT leave any blanks.
Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)					
EMPLOYEE INFORMATION					
Company Affiliation					
Tetra Tech Employee? <input type="checkbox"/> TetraTech subcontractor employee (directly supervised by Tt personnel)? <input type="checkbox"/>					
Full Name			Company (if not Tt employee)		
Street Address, City, State and Zip Code			Address Type		
			Home address (for Tt employees) <input type="checkbox"/>		
			Business address (for subcontractors) <input type="checkbox"/>		
Telephone Numbers					
Work: _____		Home: _____		Cell: _____	
Occupation (regular job title)			Department		
Was the individual performing regular job duties?			Time individual began work		
Yes <input type="checkbox"/> No <input type="checkbox"/>			_____ AM <input type="checkbox"/> PM <input type="checkbox"/> OR Cannot be determined <input type="checkbox"/>		
Safety equipment					
Provided? Yes <input type="checkbox"/> No <input type="checkbox"/>		Type(s) provided: <input type="checkbox"/> Hard hat <input type="checkbox"/> Protective clothing			
Used? Yes <input type="checkbox"/> No <input type="checkbox"/> If no, explain why		<input type="checkbox"/> Gloves <input type="checkbox"/> High visibility vest			
		<input type="checkbox"/> Eye protection <input type="checkbox"/> Fall protection			
		<input type="checkbox"/> Safety shoes <input type="checkbox"/> Machine guarding			
		<input type="checkbox"/> Respirator <input type="checkbox"/> Other (list) _____			
NOTIFICATIONS					
Name of Tt employee to whom the injury or illness was first reported			Was H&S notified within one hour of injury or illness?		
			Yes <input type="checkbox"/> No <input type="checkbox"/>		
Date of report			H&S Personnel Notified		
Time of report			Time of Report		
If subcontractor injury, did subcontractor's firm perform their own incident investigation?					
Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, request a copy of their completed investigation form/report and attach it to this report.					

INJURY / ILLNESS DETAILS

What was the individual doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the individual was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from a hand sprayer"; "Daily computer key-entry"

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor and worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; Worker developed soreness in wrist over time"

Describe the object or substance that directly harmed the individual: Examples: "Concrete floor"; "Chlorine"; "Radial Arm Saw". If this question does not apply to the incident, write "Not Applicable".

MEDICAL CARE PROVIDED

Was first aid provided at the site: Yes ☐ No ☐ If yes, describe the type of first aid administered and by whom?

Was treatment provided away from the site: Yes ☐ No ☐ If yes, provide the information below.

Name of physician or health care professional	Facility Name
<hr/>	<hr/>
Street Address, City State and Zip Code	Type of Care?
<hr/>	Was individual treated in emergency room? Yes <input type="checkbox"/> No <input type="checkbox"/>
<hr/>	Was individual hospitalized overnight as an in-patient? Yes <input type="checkbox"/> No <input type="checkbox"/>
Telephone Number	Did the individual die? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, date: <hr/>
<hr/>	Will a worker's compensation claim be filed? Yes <input type="checkbox"/> No <input type="checkbox"/>

NOTE: Attach any police reports or related diagrams to this report.

SIGNATURES

I have reviewed this report and agree that all the supplied information is accurate

Affected individual (print)	Affected individual (signature)	Telephone Number	Date
<hr/>	<hr/>	<hr/>	<hr/>

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

INSTRUCTIONS:

Complete all sections below for incidents involving property/equipment damage, fire, spill or release.
Do NOT leave any blanks.
Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)

TYPE OF INCIDENT (Check all that apply)Property Damage ☐Equipment Damage ☐Fire or Explosion ☐Spill or Release ☐**INCIDENT DETAILS****Results of Incident:** Fully describe damages, losses, etc.**Response Actions Taken:**

Responding Agency(s) (i.e. police, fire department, etc.)

Agency(s) Contact Name(s)

DAMAGED ITEMS (List all damaged items, extent of damage and estimated repair cost)

Item:

Extent of damage:

Estimated repair cost

SPILLS / RELEASES (Provide information for spilled/released materials)

Substance

Estimated quantity and duration

Specify Reportable Quantity (RQ)

Exceeded? Yes ☐ No ☐ NA ☐**FIRES / EXPLOSIONS (Provide information related to fires/explosions)**Fire fighting equipment used? Yes ☐ No ☐ If yes, type of equipment: _____**NOTIFICATIONS**

Required notifications

Name of person notified

By whom

Date / Time

Client: _____ Yes ☐ No ☐Agency: _____ Yes ☐ No ☐Other: _____ Yes ☐ No ☐Who is responsible for reporting incident to outside agency(s)? Tt ☐ Client ☐ Other ☐ Name: _____Was an additional written report on this incident generated? Yes ☐ No ☐ If yes, place in project file.

INSTRUCTIONS:

Complete all sections below for incidents involving motor vehicle accidents. Do NOT leave any blanks.
Attach this form to the IR FORM completed for this incident.

Incident Report Number: (From the IR Form)							
INCIDENT DETAILS							
Name of road, street, highway or location where accident occurred				Name of intersecting road, street or highway if applicable			
County		City			State		
Did police respond to the accident?				Did ambulance respond to the accident?			
Yes <input type="checkbox"/> No <input type="checkbox"/>				Yes <input type="checkbox"/> No <input type="checkbox"/>			
Name and location of responding police department				Ambulance company name and location			
Officer's name/badge #							
Did police complete an incident report? Yes <input type="checkbox"/> No <input type="checkbox"/> If yes, police report number: _____ Request a copy of completed investigation report and attach to this form.							
VEHICLE INFORMATION							
How many vehicles were involved in the accident? _____ (Attach additional sheets as applicable for accidents involving more than 2 vehicles.)							
Vehicle Number 1 – Tetra Tech Vehicle				Vehicle Number 2 – Other Vehicle			
Vehicle Owner / Contact Information				Vehicle Owner / Contact Information			
Color				Color			
Make				Make			
Model				Model			
Year				Year			
License Plate #				License Plate #			
Identification #				Identification #			
Describe damage to vehicle number 1				Describe damage to vehicle number 2			
Insurance Company Name and Address				Insurance Company Name and Address			
Agent Name				Agent Name			
Agent Phone No.				Agent Phone No.			
Policy Number				Policy Number			

DRIVER INFORMATION							
Vehicle Number 1 – Tetra Tech Vehicle				Vehicle Number 2 – Other Vehicle			
Driver's Name				Driver's Name			
Driver's Address				Driver's Address			
Phone Number				Phone Number			
Date of Birth				Date of Birth			
Driver's License #				Driver's License #			
Licensing State				Licensing State			
Gender		Male <input type="checkbox"/> Female <input type="checkbox"/>		Gender		Male <input type="checkbox"/> Female <input type="checkbox"/>	
Was traffic citation issued to Tetra Tech driver? Yes <input type="checkbox"/> No <input type="checkbox"/>				Was traffic citation issued to driver of other vehicle? Yes <input type="checkbox"/> No <input type="checkbox"/>			
Citation #				Citation #			
Citation Description				Citation Description			
PASSENGERS IN VEHICLES (NON-INJURED)							
<p>List all non-injured passengers (excluding driver) in each vehicle. Driver information is captured in the preceding section. Information related to persons injured in the accident (non-Tt employees) is captured in the section below on this form. Injured Tt employee information is captured on FORM IR-A</p>							
Vehicle Number 1 – Tetra Tech Vehicle				Vehicle Number 2 – Other Vehicle			
How many passengers (excluding driver) in the vehicle? ____				How many passengers (excluding driver) in the vehicle? ____			
Non-Injured Passenger Name and Address				Non-Injured Passenger Name and Address			
Non-Injured Passenger Name and Address				Non-Injured Passenger Name and Address			
Non-Injured Passenger Name and Address				Non-Injured Passenger Name and Address			
INJURIES TO NON-TETRATECH EMPLOYEES							
Name of injured person 1				Address of injured person 1			
Age	Gender	Car No.	Location in Car	Seat Belt Used?	Ejected from car?	Injury or Fatality?	
	Male <input type="checkbox"/> Female <input type="checkbox"/>			Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	Injured <input type="checkbox"/> Died <input type="checkbox"/>	
Name of injured person 2				Address of injured person 2			
Age	Gender	Car No.	Location in Car	Seat Belt Used?	Ejected from car?	Injury or Fatality?	
	Male <input type="checkbox"/> Female <input type="checkbox"/>			Yes <input type="checkbox"/> No <input type="checkbox"/>	Yes <input type="checkbox"/> No <input type="checkbox"/>	Injured <input type="checkbox"/> Died <input type="checkbox"/>	
OTHER PROPERTY DAMAGE							
Describe damage to property other than motor vehicles							
Property Owner's Name				Property Owner's Address			

COMPLETE AND SUBMIT DIAGRAM DEPICTING WHAT HAPPENED

A large, empty rectangular box with a black border, intended for drawing a diagram. It occupies the majority of the page below the header.

ATTACHMENT II
MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by on-site personnel and kept in the command post during the conduct of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project: _____

Name: _____ Home Telephone: _____

Address: _____

Age: _____ Height: _____ Weight: _____

Person to notify in the event of an emergency: Name: _____

Phone: _____

Drug or other Allergies: _____

Particular Sensitivities: _____

Do You Wear Contacts? _____

What medications are you presently using? _____

Name, Address, and Phone Number of personal physician: _____

Note: Health Insurance Portability and Accountability Act (HIPAA) Requirements

HIPAA took effect April 14, 2003. Loosely interpreted, HIPAA regulates the disclosure of Protected Health Information (PHI) by the entity collecting that information. PHI is any information about health status (such as that you may report on this Medical Data Sheet), provision of health care, or other information. HIPAA also requires Tetra Tech to ensure the confidentiality of PHI. This Act can affect the ability of the Medical Data Sheet to contain and convey information you would want a Doctor to know if you were incapacitated. So before you complete the Medical Data Sheet understand that this form will not be maintained in a secure location. It will be maintained in a file box or binder accessible to other members of the field crew so that they can accompany an injured party to the hospital.

DO NOT include information that you do not wish others to know, only information that may be pertinent in an emergency situation or treatment.

Name (Print clearly)

Signature

Date

ATTACHMENT III
EQUIPMENT INSPECTION CHECKLIST FOR DPT RIGS

Equipment Inspection Checklist for DPT Rigs

Company: _____

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____ Time: ____ :

Equipment Type: _____

HDD, MIP)

(e.g, Drill Rigs Hollow Stem, Mud Rotary, Direct Push,

Project Name: _____

Project No#: _____

Yes	No	NA	Requirement	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Emergency Stop Devices	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Emergency Stop Devices (At points of operation)	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Have all emergency shut offs identified been communicated to the field crew?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Has a person been designated as the Emergency Stop Device Operator?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Highway Use	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Cab, mirrors, safety glass?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Seat Belts?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Is the equipment equipped with audible back-up alarms and back-up lights?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Horn and gauges	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Brake condition (dynamic, park, etc.)	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Tires (Tread) or tracks	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Windshield wipers	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Exhaust system	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Steering (standard and emergency)	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Wheel Chocks?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Are tools and material secured to prevent movement during transport? Especially those within the cab?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Are there flammables or solvents or other prohibited substances stored within the cab?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Are tools or debris in the cab that may adversely influence operation of the vehicle (in and around brakes, clutch, gas pedals)	

Equipment Inspection Checklist for Drill Rigs

Page 2

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____

Yes	No	NA	Requirement	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fluid Levels: <ul style="list-style-type: none"> • Engine oil • Transmission fluid • Brake fluid • Cooling system fluid • Hoses and belts • Hydraulic oil 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	High Pressure Hydraulic Lines <ul style="list-style-type: none"> • Obvious damage • Operator protected from accidental release • Coupling devices, connectors, retention cables/pins are in good condition and in place 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Mast Condition <ul style="list-style-type: none"> • Structural components/tubing • Connection points • Pins • Welds • Outriggers • Operational • Plumb (when raised) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hooks <ul style="list-style-type: none"> • Are the hooks equipped with Safety Latches? • Does it appear that the hook is showing signs of wear in excess of 10% original dimension? • Is there a bend or twist exceeding 10% from the plane of an unbent hook? • Increase in throat opening exceeding 15% from new condition • Excessive nicks and/or gouges • Clips • Number of U-Type (Crosby) Clips (cable size 5/16 – 5/8 = 3 clips minimum) (cable size 3/4 – 1 inch = 4 clips minimum) (cable size 1 1/8 – 1 3/8 inch = 5 clips minimum) 	

Equipment Inspection Checklist for Drill Rigs

Page 3

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____

Yes	No	NA	Requirement	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Power cable and/or hoist cable	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Reduction in Rope diameter π (5/16 wire rope > 1/64 reduction nominal size -replace) (3/8 to 1/2 wire rope > 1/32 reduction nominal size-replace) (9/16 to 3/4 wire rope > 3/64 reduction nominal size-replace) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Number of broken wires (6 randomly broken wires in one rope lay) (3 broken wires in one strand) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Number of wire rope wraps left on the Running Drum at nominal use (≥ 3 required) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> - Lead (primary) sheave is centered on the running drum 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Lubrication of wire rope (adequate?) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Kinks, bends – Flattened to > 50% diameter 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Hemp/Fiber rope (Cathead/Split Spoon Hammer)	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Minimum $\frac{3}{4}$; maximum 1 inch rope diameter (Inspect for physical damage) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Rope to hammer is securely fastened 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Safety Guards –	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Hot pipes and surfaces exposed to accidental contact? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> High pressure lines 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Nip/pinch points 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Operator Qualifications	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Does the operator have proper licensing where applicable, (e.g., CDL)? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Does the operator, understand the equipment's operating instructions? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Is the operator experienced with this equipment? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Is the operator 21 years of age or more? 	

Equipment Inspection Checklist for Drill Rigs

Page 4

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____

Yes	No	NA	Requirement	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PPE Required for Drill Rig Exclusion Zone	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Hardhat	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Safety glasses	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Work gloves	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Chemical resistant gloves _____	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Steel toed Work Boots	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Chemical resistant Boot Covers	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Apron	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Coveralls Tyvek, Saranex, cotton) _____	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Other Hazards	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Excessive Noise Levels? _____ dBA	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Chemical hazards (Drilling supplies - Sand, bentonite, grout, fuel, etc.)	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- MSDSs available?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	• Will On-site fueling occur	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Safety cans available?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	- Fire extinguisher (Type/Rating - _____)	

Approved for Use ☐ Yes ☐ No ☐ See Comments

Site Health and Safety Officer

Operator

ATTACHMENT IV
HEAVY EQUIPMENT INSPECTION CHECKLIST

Heavy Equipment Inspection Checklist

Company: _____

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____

Time: ____ : ____

Equipment Type: _____

(e.g., earthmoving equipment - tractors backhoes, bulldozers, etc.)

Project Name: _____

Project No#: _____

Yes	No	NA	Requirements	Comments
<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	Seat Belts <ul style="list-style-type: none"> Are available for intended operator and passengers (where applicable) Seat Belts are operational? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Roll-Over Protection (ROPS) <ul style="list-style-type: none"> Roll-over protection structures (ROPS) are provided on vehicles and heavy equipment (including scrapers, tractors, loaders, bulldozers, carryalls, etc.) 	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Brakes <ul style="list-style-type: none"> Brake systems capable of stopping and holding fully loaded equipment Parking Brake functions properly Wheel Chocks available (where and as applicable) 	
<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	Access <ul style="list-style-type: none"> Non-slip steps Grab Handles (3-Point Grab/Step Mounting Points) 	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Audible Alarms <ul style="list-style-type: none"> Audible alarms – All bidirectional machines, such as rollers, compacters, front-end loaders, bulldozers, and similar equipment, shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction. <ul style="list-style-type: none"> Back up Alarms – All self propelled equipment with an obstructed view to the rear will be equipped with a reverse gear signal alarm distinguishable from the surrounding noise level. Horn functioning properly 	

Equipment Inspection Checklist for Heavy Equipment

Page 2

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____

Yes	No	NA	Requirements	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Highway Use	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Fenders for equipment that can exceed 15mph 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Fire Extinguisher 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Are exhaust emissions directed away from the Operator? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Cab 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> - Clean, free from debris, tools or equipment that can interfere with foot Control. 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> - Free from storage of flammable material/solvents 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Mirrors, 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Safety glass 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> - Equipped with defrosters 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> - Windshield wipers 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Gauges functioning properly 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Tires (Tread) or tracks 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Steering (standard and emergency) 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Are tools and material secured to prevent movement during transport? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fluid Levels:	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Engine oil 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Transmission fluid 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Brake fluid 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Cooling system fluid 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Hoses and belts 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<ul style="list-style-type: none"> Hydraulic oil 	

Equipment Inspection Checklist for Heavy Equipment

Page 3

Unit/Serial No#: _____

Inspection Date: ____/____/____

Yes	No	NA	Requirements	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fueling <ul style="list-style-type: none"> Fueling of vehicles and heavy equipment is done with the engine off. No smoking is permitted at or near the fuel storage or refueling area. A sign is posted stating: NO SMOKING WITHIN 50 FEET. No sources of ignition are present near the fuel storage or refueling area. A dry chemical or carbon dioxide fire extinguisher (rated 6:BC or larger) is in a location accessible to the fueling area, no closer than 50-feet. Safety cans available? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Safety Guards – <ul style="list-style-type: none"> Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact? Hot pipes and surfaces are protected from accidental contact? High pressure pneumatic lines have safety cable to prevent thrashing should it become disconnected? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Attachments <ul style="list-style-type: none"> Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use? 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Operator Qualifications <ul style="list-style-type: none"> Does the operator have proper licensing where applicable, (e.g., CDL)? Does the operator, understand the equipment's operating instructions? Is the operator experienced with this equipment? Is the operator 21 years of age or more? 	

Equipment Inspection Checklist for Heavy Equipment
Page 4

Unit/Serial No#: _____

Inspection Date: ____ / ____ / ____

Yes	No	NA	Requirements	Comments
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	PPE Required <ul style="list-style-type: none"> • Hardhat • Safety glasses • Work gloves • Chemical resistant gloves _____ • Steel toed Work Boots • Chemical resistant Boot Covers • Apron • Coveralls Tyvek, Saranex, cotton) _____ 	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Key(s)? Operating Manual?	
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Other Hazards <ul style="list-style-type: none"> • Excessive Noise Levels _____ dBA • Chemical hazards (Drilling supplies - Sand, bentonite, grout, fuel, etc.) - MSDSs available? 	

Approved for Use ☐ Yes ☐ No ☐ See Comments

Site Health and Safety Officer

Operator

ATTACHMENT V
SAFE WORK PERMITS

**SAFE WORK PERMIT
MOBILIZATION AND DEMOBILIZATION ACTIVITIES
DETROIT ATWATER**

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** Mobilization and demobilization activities

II. **Primary Hazards:** Lifting; slips, trips and falls; vehicular and foot traffic; insect/animal bites and stings; poisonous plants; inclement weather.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech

Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech

V. **Protective equipment required**

Level D ☒ Level B ☐

Level C ☐ Level A ☐

Respiratory equipment required

Yes ☐ Specify on the reverse

No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

VI. **Chemicals of Concern**

None

Hazard Monitoring/Action Level(s)

NA

Response Measures

NA

Primary Route(s) of Exposure/Hazard: NA

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat..... ☐ Yes ☐ No

Safety Glasses ☐ Yes ☐ No

Chemical/splash goggles ☐ Yes ☒ No

Splash Shield..... ☐ Yes ☒ No

Splash suits/coveralls ☐ Yes ☒ No

Impermeable apron..... ☐ Yes ☒ No

Safety toe work shoes/boots..... ☒ Yes ☐ No

High visibility vest ☐ Yes ☐ No

First Aid Kit ☐ Yes ☐ No

Safety Shower/Eyewash..... ☐ Yes ☐ No

Hearing Protection (Plugs/Muffs) ... ☐ Yes ☐ No

Safety belt/harness ☐ Yes ☒ No

Radio/Cellular Phone..... ☐ Yes ☒ No

Barricades ☐ Yes ☒ No

Gloves (Type – Work)..... ☒ Yes ☐ No

Work/rest regimen ☐ Yes ☒ No

Chemical Resistant Boot Covers ... ☐ Yes ☐ No

Tape up/use insect repellent ☐ Yes ☐ No

Fire Extinguisher..... ☐ Yes ☐ No

Other..... ☐ Yes ☐ No

Modifications/Exceptions: Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass. Hard hat when overhead hazards exist. Safety glasses when near eye hazards. Hearing protection when in high noise areas.

VIII. **Site Preparation**

Utility Locating and Excavation Clearance completed ☐ Yes ☐ No ☐ NA

Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place ☐ Yes ☐ No ☐ NA

Physical Hazards Identified and Isolated (Splash and containment barriers) ☐ Yes ☐ No ☐ NA

Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)..... ☐ Yes ☐ No ☐ NA

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.)..... ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary.

Permit Issued by: _____ Permit Accepted by: _____

**SAFE WORK PERMIT
SOIL BORING/SAMPLING
DETROIT ATWATER**

Permit No. _____ Date: _____ Time: From _____ to _____

- I. Work limited to the following (description, area, equipment used):** Soil boring and sampling via DPT.
- II. Primary Hazards:** Chemical contamination; transfer of contamination; heavy equipment hazards; elevated noise; energized systems/utilities; heavy lifting; slip, trip and fall; cuts and lacerations; vehicular and foot traffic; ambient temperature extremes; flying projectiles; inclement weather
- III. Field Crew:** _____
- IV. On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech
- Equipment Inspection required** ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech

- V. Protective equipment required** **Respiratory equipment required**
- Level D ☒ Level B ☐ Yes ☐ Specify on the reverse
- Level C ☐ Level A ☐ No ☒
- Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

- | VI. Chemicals of Concern | Hazard Monitoring /Action Level(s) | Response Measures |
|---------------------------------|---|--------------------------|
| <u>PAHs</u> | <u>none</u> | <u>none</u> |
| <u>Dusts (metals)</u> | <u>visible dust</u> | <u>area wetting</u> |

Primary Route(s) of Exposure/Hazard: inhalation, dermal, ingestion

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

- VII. Additional Safety Equipment/Procedures**
- | | | | |
|----------------------------------|---|---------------------------------------|--|
| Hard-hat..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Hearing Protection (Plugs/Muffs)..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Safety Glasses | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Safety belt/harness/lifeline..... | <input checked="" type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical/splash goggles | <input type="checkbox"/> Yes <input type="checkbox"/> No | Radio/Cellular Phone..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash Shield..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | Barricades | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash suits/coveralls | <input type="checkbox"/> Yes <input type="checkbox"/> No | Gloves (Type – Work)..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Impermeable apron..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Work/rest regimen | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Safety toe work shoes/boots..... | <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Chemical Resistant Boot Covers | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| High visibility vest | <input type="checkbox"/> Yes <input type="checkbox"/> No | Tape up/use insect repellent | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| First Aid Kit | <input type="checkbox"/> Yes <input type="checkbox"/> No | Fire Extinguisher..... | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Safety Shower/Eyewash..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | Other..... | <input type="checkbox"/> Yes <input type="checkbox"/> No |
- Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety footwear, and nitrile gloves Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass.

- VIII. Site Preparation**
- | | Yes | No | NA |
|--|--------------------------|--------------------------|--------------------------|
| Utility Locating and Excavation Clearance completed | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physical Hazards Identified and Isolated (Splash and containment barriers) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- IX. Additional Permits required** (Hot work, confined space entry, excavation etc.)..... ☐ Yes ☒ No
- If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090*

- X. Special instructions, precautions:** Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary. Complete Heavy Equipment Inspection Checklist prior to beginning work. Must complete DPT equipment inspection checklist prior to beginning work.

Permit Issued by: _____ Permit Accepted by: _____

**SAFE WORK PERMIT
MONITORING WELL INSTALLATION
AND GROUNDWATER SAMPLING
DETROIT ATWATER**

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** Monitoring well installation via HSA and groundwater sampling

II. **Primary Hazards:** Chemical contamination; transfer of contamination; heavy equipment hazards; elevated noise; energized systems/utilities; heavy lifting; slip, trip and fall; cuts and lacerations; vehicular and foot traffic; ambient temperature extremes; flying projectiles; inclement weather

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech

V. **Protective equipment required**

Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required

Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, or coveralls, safety glasses and safety footwear. Hard hats and hearing protection will be worn when working near operating equipment.

VI. **Chemicals of Concern**

PAHs

Hazard Monitoring /Action Level(s)

none

Response Measures

none

Dusts (metals)

visible dust

area wetting

Primary Route(s) of Exposure/Hazard: inhalation, dermal, ingestion

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat.....	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Hearing Protection (Plugs/Muffs).....	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Safety Glasses	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Safety belt/harness/lifeline	<input checked="" type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Chemical/splash goggles	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Radio/Cellular Phone.....	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Splash Shield.....	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Barricades	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Splash suits/coveralls	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Gloves (Type – Work).....	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
Impermeable apron.....	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	Work/rest regimen	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No
Safety toe work shoes/boots.....	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Chemical Resistant Boot Covers	<input type="checkbox"/> Yes	<input type="checkbox"/> No
High visibility vest	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Tape up/use insect repellent	<input type="checkbox"/> Yes	<input type="checkbox"/> No
First Aid Kit	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Fire Extinguisher.....	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Safety Shower/Eyewash.....	<input type="checkbox"/> Yes	<input type="checkbox"/> No	Other.....	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety footwear, and nitrile gloves Tyvek coverall to protect against natural hazards (e.g., ticks) if working/walking through areas of high grass.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical Hazards Identified and Isolated (Splash and containment barriers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.)..... ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Review PPE needs based on activities being performed and the associated hazards. Use safe lifting procedures and obtain assistance when handling heavy or awkward objects. Suspend site activities in the event of inclement weather. Observe site workers for signs and symptoms of heat/cold stress. Use sun block (SPF > 15) to prevent sunburn if necessary. Complete Heavy Equipment Inspection Checklist prior to beginning work. Must complete heavy equipment inspection checklist prior to beginning work.

Permit Issued by: _____ Permit Accepted by: _____

**SAFE WORK PERMIT
DECONTAMINATION ACTIVITIES
DETROIT ATWATER**

Permit No. _____ Date: _____ Time: From _____ to _____

I. **Work limited to the following (description, area, equipment used):** Decontamination of sampling and heavy equipment using high pressure steamer, if necessary.

II. **Primary Hazards:** Chemical exposure, transfer of contamination, inclement weather, noise.

III. **Field Crew:** _____

IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech
Equipment Inspection required ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech

V. **Protective equipment required**

Level D ☒ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required

Yes ☐ Specify on the reverse
No ☒

Modifications/Exceptions: Minimum requirement include sleeved shirt and long pants, safety glasses, safety footwear, and nitrile gloves. Impermeable aprons are preferred protection against soiling work clothes when lifting auger flights because of the need to carry close to the body. If it (impermeable apron) does not offer adequate protection, PVC rain suits or PE or PVC coated Tyvek should be employed. Chemical resistant boot covers if excessive liquids are generated or to protect footwear.

VI. **Chemicals of Concern**

Decontamination Fluids

Hazard Monitoring

refer to MSDS

Action Level(s)

refer to MSDS

Response Measures

refer to MSDS

Primary Route(s) of Exposure/Hazard: Inhalation and direct contact

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes, No, or NA)

VII. **Additional Safety Equipment/Procedures**

Hard-hat.....	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Hearing Protection (Plugs/Muffs)...	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Safety Glasses	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Safety belt/harness	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Chemical/splash goggles.....	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Radio/Cellular Phone.....	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Splash Shield.....	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Barricades	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Splash suits/coveralls	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Gloves (Type – Nitrile)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Impermeable apron.....	<input type="checkbox"/> Yes <input type="checkbox"/> No	Work/rest regimen	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Safety toe Work shoes or boots.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	Chemical Resistant Boot Covers ...	<input type="checkbox"/> Yes <input type="checkbox"/> No
Visibility vest	<input type="checkbox"/> Yes <input type="checkbox"/> No	Tape up/use insect repellent	<input type="checkbox"/> Yes <input type="checkbox"/> No
First Aid Kit	<input type="checkbox"/> Yes <input type="checkbox"/> No	Fire Extinguisher.....	<input type="checkbox"/> Yes <input type="checkbox"/> No
Safety Shower/Eyewash.....	<input type="checkbox"/> Yes <input type="checkbox"/> No	Other.....	<input type="checkbox"/> Yes <input type="checkbox"/> No

Modifications/Exceptions: Chemical resistant boot covers if excessive liquids are generated or to protect footwear.

VIII. **Site Preparation**

	Yes	No	NA
Utility Locating and Excavation Clearance completed	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Physical Hazards Identified and Isolated (Splash and containment barriers)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

IX. **Additional Permits required** (Hot work, confined space entry, excavation etc.)..... ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

X. **Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques. When/where possible use heavy equipment to move and place containers.

Permit Issued by: _____ Permit Accepted by: _____

**SAFE WORK PERMIT
IDW MANAGEMENT
DETROIT ATWATER**

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

- I. **Work limited to the following (description, area, equipment used):** IDW management activities includes containerization, staging, monitoring for leaks of IDW accumulated wastes. Wastes types include purge and decontamination wash waters.
- II. **Primary Hazards:** Lifting, pinches and compressions; flying projectiles; slips, trips, and falls and chemical contamination.
- III. **Field Crew:** _____
- IV. **On-site Inspection conducted** ☐ Yes ☐ No Initials of Inspector _____ Tetra Tech
Equipment Inspection required ☐ Yes ☒ No Initials of Inspector _____ Tetra Tech

SECTION II: General Safety Requirements (To be filled in by permit issuer)

- V. **Protective equipment required** **Respiratory equipment required**
Level D ☒ Level B ☐ Yes ☐ See Reverse
Level C ☐ Level A ☐ No ☒
Modifications/Exceptions: None anticipated

- | | | |
|--|--|---|
| VI. Chemicals of Concern
<u>None anticipated</u> | Hazard Monitoring /Action Level(s)
<u>none</u> | Response Measures
<u>none</u> |
|--|--|---|

Primary Route of Exposure/Hazard: NA

(Note to FOL and/or SHSO: Each item in Sections VII, VIII, and IX must be checked Yes or No)

VII. Additional Safety Equipment/Procedures

- | | |
|--|---|
| Hard-hat..... <input type="checkbox"/> Yes <input type="checkbox"/> No
Safety Glasses <input type="checkbox"/> Yes <input type="checkbox"/> No
Chemical/splash goggles..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Splash Shield..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Splash suits/coveralls <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Impermeable apron..... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Safety toe work shoes/boots..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
High visibility vest <input type="checkbox"/> Yes <input type="checkbox"/> No
First Aid Kit <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Safety Shower/Eyewash <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Hearing Protection (Plugs/Muffs) ... <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Safety belt/harness <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Radio/Cellular Phone..... <input type="checkbox"/> Yes <input type="checkbox"/> No
Barricades <input type="checkbox"/> Yes <input type="checkbox"/> No
Gloves (Type – Leather/Cotton)..... <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Work/rest regimen <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Chemical Resistant Boot Covers <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Tape up/use insect repellent <input type="checkbox"/> Yes <input type="checkbox"/> No
Fire Extinguisher..... <input type="checkbox"/> Yes <input type="checkbox"/> No
Other..... <input type="checkbox"/> Yes <input type="checkbox"/> No |
|--|---|

Modifications/Exceptions: If you are using pneumatic/electric power to open drums – Safety glasses are required; if power equipment is employed to move drums or you are working near operating equipment hard hats will be employed. High visibility vest if near active traffic areas.

VIII. Site Preparation

- | | | | |
|---|--------------------------|--------------------------|-------------------------------------|
| | Yes | No | NA |
| Utility Locating and Excavation Clearance completed | <input type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> |
| Vehicle and Foot Traffic Routes Established/Traffic Control Barricades/Signs in Place | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Physical Hazards Identified and Isolated | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Emergency Equipment Staged (Spill control, fire extinguishers, first aid kits, etc)..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

- IX. Additional Permits required** (Hot work, confined space entry, excavation etc.)..... ☐ Yes ☒ No
If yes, SHSO to complete or contact Health Sciences, Pittsburgh Office (412)921-7090

- X. Special instructions, precautions:** Suspend site activities in the event of inclement weather. Employ proper lifting techniques. When/where possible use heavy equipment to move and place containers. When placing drums – Place the label and retention ring nut on the outside where it is readily visible. Place 4-drums to a pallet. Maintain a minimum distance of 4-feet between pallet rows. An IDW inventory shall be generated to provide the number of drums, contents, and volumes. This inventory should be provided to the facility contact. Inspect equipment prior to use.

Permit Issued by: _____ Permit Accepted by: _____

ATTACHMENT VI
OSHA POSTER

Job Safety and Health

It's the law!

EMPLOYEES:

- You have the right to notify your employer or OSHA about workplace hazards. You may ask OSHA to keep your name confidential.
- You have the right to request an OSHA inspection if you believe that there are unsafe and unhealthful conditions in your workplace. You or your representative may participate in that inspection.
- You can file a complaint with OSHA within 30 days of retaliation or discrimination by your employer for making safety and health complaints or for exercising your rights under the *OSH Act*.
- You have the right to see OSHA citations issued to your employer. Your employer must post the citations at or near the place of the alleged violations.
- Your employer must correct workplace hazards by the date indicated on the citation and must certify that these hazards have been reduced or eliminated.
- You have the right to copies of your medical records and records of your exposures to toxic and harmful substances or conditions.
- Your employer must post this notice in your workplace.
- You must comply with all occupational safety and health standards issued under the *OSH Act* that apply to your own actions and conduct on the job.

EMPLOYERS:

- You must furnish your employees a place of employment free from recognized hazards.
- You must comply with the occupational safety and health standards issued under the *OSH Act*.

**This free poster available from OSHA –
The Best Resource for Safety and Health**



**Occupational Safety
and Health Administration**
U.S. Department of Labor



Free assistance in identifying and correcting hazards or complying with standards is available to employers, without citation or penalty, through OSHA-supported consultation programs in each state.

1-800-321-OSHA
www.osha.gov

OSHA 3165-12-06R

Appendix B

Standard Operating Procedures

Soil Sampling

Direct Push Technology

Borehole and Sample Logging

Non-Radiological Sample
Handling


Decontamination of Field
Equipment

Groundwater Monitoring Well
Installation

Groundwater Sample Acquisition
and Onsite Water Quality Testing



STANDARD OPERATING PROCEDURES

Number	SA-1.3	Page	1 of 31
Effective Date	04/072008	Revision	9
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	 Tom Johnston		

Subject
SOIL SAMPLING

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the procedures to be used to collect surface, near-surface, and subsurface soil samples. Additionally, it describes the methods for sampling of test pits and trenches to determine subsurface soil and rock conditions and for recovery of small-volume or bulk samples from pits.

2.0 SCOPE

This document applies to the collection of surface, near-surface, and subsurface soil samples exposed through hand digging, hand augering, drilling, or machine excavating at hazardous substance sites for laboratory testing, onsite visual examination, and onsite testing.

3.0 GLOSSARY

Composite Sample - A composite sample is a combination of more than one grab sample from various locations and/or depths and times that is homogenized and treated as one sample. This type of sample is usually collected when determination of an average waste concentration for a specific area is required. Composite samples shall not be collected for volatile organics analysis.

Confined Space - As stipulated in 29 Code of Federal Regulations (CFR) 1910.146, a confined space means a space that: (1) is large enough and so configured that an employee can bodily enter and perform assigned work; (2) has limited or restricted means for entry or exit (e.g., tanks, vessels, silos, storage bins, hoppers, vaults, pits, and excavations); and (3) is not designed for continuous employee occupancy. TtNUS considers all confined space as permit-required confined spaces.

Grab Sample - One sample collected at one location and at one specific time.

Hand Auger - A sampling device used to extract soil from the ground.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

Sample for Non-Volatile Analyses - Includes all chemical parameters other than volatile organics (e.g., semivolatiles, pesticides/PCBs, metals, etc.) and those engineering parameters that do not require undisturbed soil for their analysis.

Split-Barrel Sampler - A steel tube, split in half lengthwise, with the halves held together by threaded collars at either end of the tube. Also called a split-spoon sampler, this device can be driven into resistant materials using a drive weight mounted in the drilling string. A standard split-barrel sampler is typically available in two common lengths, providing either 20-inch or 26-inch longitudinal clearance for obtaining 18-inch or 24-inch-long samples, respectively. These split-barrel samplers commonly range in size from 2 to 3.5 inches OD. The larger sizes are commonly used when a larger volume of sample material is required (see Attachment B).

Test Pit and Trench - Open, shallow excavations, typically rectangular (if a test pit) or longitudinal (if a trench), excavated to determine shallow subsurface conditions for engineering, geological, and soil chemistry exploration and/or sampling purposes. These pits are excavated manually or by machine (e.g., backhoe, clamshell, trencher, excavator, or bulldozer).

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Thin-Walled Tube Sampler - A thin-walled metal tube (also called a Shelby tube) used to recover relatively undisturbed soil samples. These tubes are available in various sizes, ranging from 2 to 5 inches outside diameter (OD) and from 18 to 54 inches in length.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, selecting proposed sampling locations, and selecting field procedures used in the collection of soil samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager establishes the need for test pits or trenches and determines their approximate locations and dimensions.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan. This will include (but not be limited to) performing air quality monitoring during sampling, boring, and excavation activities and to ensure that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO/designee may also be required to advise the FOL on other safety-related matters regarding boring, excavation, and sampling, such as mitigative measures to address potential hazards from unstable trench walls, puncturing of drums or other hazardous objects, etc.

Field Operations Leader (FOL) - This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is responsible for finalizing the locations for collection of surface, near-surface, and subsurface (hand and machine borings, test pits/trenches) soil samples. He/she is ultimately responsible for the sampling and backfilling of boreholes, test pits, and trenches and for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP and/or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, test pit logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Competent Person - A Competent Person, as defined in 29 CFR 1929.650 of Subpart P - Excavations, means one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.

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- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Health and safety precautions are identified for individual sample collection procedures throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard or uneven surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas, along roadways and highways.

Methods of avoiding these hazards are provided below.

Knee injuries – If kneeling is required during soil sampling, this could result in knee injuries from stones/foreign objects and general damage due to stress on the joints. To minimize this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.
- Stretch ligaments, tendons and muscles before, during and after. Take breaks as frequently as necessary.
- Report pre-existing conditions to the SSO if you feel this activity will aggravate an existing condition.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample locations. To minimize these hazards:

- Pre-survey sampling locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations - To prevent cuts and lacerations associated with soil sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.

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- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.
- Secure items to be cut – do not hold them against the opposing hand, a leg, or other body part.
- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken sample jars or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities – ASSUME THEY DO NOT SEE YOU OR MEMBERS OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind spot.
- **Provide a required free space of travel.** Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- Face Traffic. Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver. Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

6.0 PROCEDURES

The following procedures address surface and subsurface sampling.

CAUTION

Each situation must be evaluated individually to determine the applicability and necessity for obtaining a utility clearance ticket/dig permit. Common sense dictates, prior to digging or boring with power equipment, no matter what the depth, or digging by hand in a manner that could damage unprotected underground utilities, that a dig permit is required. See SOP HS-1.0, Utility Locating and Excavation Clearance, for additional clarification. If you do not know or are unsure as to whether a ticket is necessary – **Get the Ticket.**

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6.1 Overview

Soil sampling is an important adjunct to groundwater monitoring. Sampling of the soil horizons above the groundwater table can detect contaminants before they migrate to the water table, and can establish the amount of contamination absorbed or adsorbed on aquifer solids that have the potential of contributing to groundwater contamination.

Soil types can vary considerably on a hazardous waste site. These variations, along with vegetation, can affect the rate of contaminant migration through the soil. It is important, therefore, that a detailed record be maintained during sampling operations, particularly noting sampling locations, depths, and such characteristics as grain size, color, and odor. Subsurface conditions are often stable on a daily basis and may demonstrate only slight seasonal variation especially with respect to temperature, available oxygen and light penetration. Changes in any of these conditions can radically alter the rate of chemical reactions or the associated microbiological community, thus further altering specific site conditions. Certain vegetation species can create degradation products that can alter contaminant concentrations in soil. This is why vegetation types and extent of degradation of this foliage must be recorded. To prevent degradation, samples must be kept at their at-depth temperature or lower, protected from direct light, sealed tightly in approved glass containers, and be analyzed as soon as possible after collection. In addition, to the extent possible, vegetation should be removed from the sample.

The physical properties of the soil, its grain size, cohesiveness, associated moisture, and such factors as depth to bedrock and water table, will limit the depth from which samples can be collected and the method required to collect them. It is the intent of this document to present the most commonly employed soil sampling methods used at hazardous waste sites.

6.2 Soil Sample Collection

6.2.1 Procedure for Preserving and Collecting Soil Samples for Volatile Organic Compound Analysis

Samples collected using traditional methods such as collection in a jar with no preservation have been known to yield non-representative samples due to loss of volatile organic compounds (VOCs). To prevent such losses, preservation of samples with methanol or sodium bisulfate may be used to minimize volatilization and biodegradation. This preservation may be performed either in the field or laboratory, depending on the sampling methodology employed. Because of the large number of sampling methods and associated equipment required, careful coordination between field and laboratory personnel is needed.

Soil samples to be preserved by the laboratory are currently being collected using Method SW-846, 5035. For samples preserved in the field, laboratories are currently performing low-level analyses (sodium bisulfate preservation) and high- to medium-level analyses (methanol preservation) depending on the needs of the end user.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

6.2.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for volatile organic analysis that are to be preserved at the laboratory shall be obtained using a hermetically sealed sample vial such as an EnCore™ sampler. Each sample shall be

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obtained using a reusable sampling handle (T-handle) that can be provided with the EnCore™ sampler when requested and purchased. Collect the sample in the following manner for each EnCore™ sampler:

1. Scene Safety - Evaluate the area where sampling will occur. Ensure that the area is safe from physical, chemical, and natural hazards. Clear or barricade those hazards that have been identified.
2. Wear the appropriate personal protective equipment (PPE). This will include, at a minimum, safety glasses and nitrile surgeon's gloves. If you must kneel on the ground or place equipment on the surface being sampled, cover the ground surface with plastic to minimize surface contamination of your equipment and clothing. Wear knee pads to protect your knees from kneeling on hard or uneven surfaces.
3. Load the Encore™ sampler into the T-handle with the plunger fully depressed.
4. Expose the area to be sampled using a hand trowel or similar device to remove surface debris.
5. Press the T-handle against the freshly exposed soil surface, forcing soil into the sampler. The plunger will be forced upward as the cavity fills with soil.
6. When the sampler is full, rotate the plunger and lock it into place. If the plunger does not lock, the sampler is not full. This method ensures there is no headspace. Soft soil may require several plunges or forcing soil against a hard surface such as a sample trowel to ensure that headspace is eliminated.
7. Use a paper towel to remove soil from the side of the sampler so a tight seal can be made between the sample cap and the rubber O-ring.
8. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler.
9. Remove any surface soil from the outside of the sampler and place in the foil bag provided with the sampler. Good work hygiene practices and diligent decontamination procedures prevents the spread of contamination even on the outside of the containers.
10. Label the bag with appropriate information in accordance with SOP SA-6.3.
11. Place the full sampler inside a lined cooler with ice and cool to $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Make sure any required trip blanks and temperature blanks are also in the cooler. Secure custody of the cooler in accordance with SOP SA-6.3.
12. Typically, collect three Encore™ samplers at each location. Consult the SAP or laboratory to determine the required number of Encore™ samplers to be collected.
13. The T-handle shall be decontaminated before moving to the next interval or location using a soap and water wash and rinse, and where applicable, the selected solvent as defined in the project planning documents.

Using this type of sampling device eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each Encore™ sampler.

After the Encore™ samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours (following the chain-of-custody and documentation procedures outlined in SOP SA-6.1). Samples must be preserved by the laboratory within 48 hours of sample collection.

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6.2.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analyses using both the low-level (sodium bisulfate preservation) and high- to medium-level (methanol preservation) methods.

Safety Reminder

When using chemicals in the field to preserve samples, the FOL and/or SSO must ensure that Materials Safety Data Sheets (MSDSs) have been provided with the chemicals to be used. They also must ensure that these chemicals have been added to the Chemical Inventory List contained within Section 5.0, Hazard Communication, of your Health and Safety Guidance Manual (HSGM). Lastly, but most importantly, the FOL and/or SSO must review the hazards with personnel using these chemicals and ensure that provisions are available for recommended PPE and emergency measures (e.g., eyewash, etc.).

Methanol Preservation (High to Medium Level):

Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Soil samples to be preserved in the field with methanol shall utilize 40 to 60 mL glass vials with septum-lined lids. Each sample bottle shall be filled with 25 mL of demonstrated analyte-free purge-and-trap grade methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

CAUTION

NEVER attempt to pipette by mouth

In situations where personnel are required to spike the septum using a hypodermic needle, the following provisions for handling sharps must be in place:

- Training of personnel regarding methods for handling of sharps
- Hard-sided containers for the disposal of sharps
- Provisions for treatment in cases where persons have received a puncture wound

Soil shall be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable tube/plunger-type syringe with the tip cut off. The outside diameter of the coring device must be smaller than the inside diameter of the sample bottle neck.

A small electronic balance or manual scale will be necessary for measuring the volume of soil to be added to the methanol-preserved sample bottle. Calibration of the scale shall be performed prior to use and intermittently throughout the day according to the manufacturer's requirements.

The sample should be collected as follows:

1. Weigh the unused syringe and plunger to the nearest 0.01 gram.
2. Pull the plunger back and insert the syringe into the soil to be sampled.
3. Collect 8 to 12 grams of soil by pushing the syringe barrel into the soil.
4. Weigh the sample and adjust until obtaining the required amount of sample.

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5. Record the sample weight to the nearest 0.01 gram in the field logbook and/or on the sample log sheet.
6. Extrude the weighed soil sample into the methanol-preserved sample bottle taking care not to contact the sample container with the syringe.
7. If dirty, wipe soil particles from the threads of the bottle and cap. Cap the bottle tightly.
8. After capping the bottle, swirl the sample (do not shake) in the methanol and break up the soil such that all of the soil is covered with methanol.
9. Place the sample on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

Sodium Bisulfate Preservation (Low Level):

CAUTION

Care should be taken when adding the soil to the sodium bisulfate solution. A chemical reaction of soil containing carbonates (limestone) may cause the sample to effervesce or the vial to possibly explode. To avoid this hazard or hazards of this type, a small sample aliquot should be subjected to the sample preservative. If it effervesces in an open air environment, utilize an alternative method such as Encore™ or 2-ounce jar.

Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be preserved in the field using the sodium bisulfate method are to be prepared and collected as follows:

1. Add 1 gram of sodium bisulfate to 5 mL of laboratory-grade deionized water in a 40 to 60 mL glass vial with septum-lined lid.
2. Collect the soil sample and record the sample weight to the nearest 0.01 gram in the field logbook or on the sample log sheet as described for methanol preservation
3. Add the weighed sample to the sample vial.
4. Collect duplicate samples using the methanol preservation method on a one-for-one sample basis because it is necessary for the laboratory to perform both low-level and medium-level analyses.
5. Place the samples on ice immediately and prepare for shipment to the laboratory as described in SOP SA-6.1.

NOTE

If lower detection limits are necessary, an option to field preserving with sodium bisulfate may be to collect EnCore™ samplers at a given sample location. Consult the planning documents to determine whether this is required. If it is, collect samples in accordance with the Encore™ sampling procedure above and then send all samplers to the laboratory to perform the required preservation and analyses.

6.2.2 Procedure for Collecting Soil Samples for Non-Volatile Analyses

Samples collected for non-volatile analyses may be collected as either grab or composite samples as follows:

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1. With a stainless steel trowel or other approved tool, transfer a portion of soil to be sampled to a stainless steel bowl or disposable inert plastic tray.
2. Remove roots, vegetation, sticks, and stones larger than the size of a green pea.
3. Thoroughly mix the soil in the bowl or tray to obtain as uniform a texture and color as practicable. The soil type, moisture content, amount of vegetation, and other factors may affect the amount of time required to obtain a properly mixed sample. In some cases, it may be impossible to obtain a uniform sample appearance. Use the field logbook to describe any significant difficulties encountered in obtaining a uniform mixture.
4. Transfer the mixed soil to the appropriate sample containers and close the containers.
5. Label the sample containers in accordance with SOP SA-6.3.
6. Place the containers in a cooler of ice as soon after collection as possible.
7. Prepare the sample shipment and ship the samples in accordance with SOP SA-6.1.

NOTE

Cooling may not be required for some samples depending on the scheduled analyses. Consult the planning documents if in doubt regarding correct sample preservation conditions. When in doubt – Cool to 4° C.

NOTE

Head space is permitted in soil sample containers for non-volatile analyses to allow for sample expansion.

6.2.3 Procedure for Collecting Undisturbed Soil Samples

NOTE

Use of thin-walled undisturbed tube samplers is restricted by the consistency of the soil to be sampled. Often, very loose and/or wet samples cannot be retrieved by the samplers, and soil with a consistency in excess of very stiff cannot be penetrated by the sampler. Devices such as Dennison or Pitcher core samplers can be used to obtain undisturbed samples of stiff soil. Using these devices normally increases sampling costs, and therefore their use should be weighed against the need for acquiring an undisturbed sample. These devices are not discussed in this SOP because they are not commonly used.

When it is necessary to acquire undisturbed samples of soil for purposes of engineering parameter analysis (e.g., permeability), a thin-walled, seamless tube sampler (Shelby tube) shall be employed using the following collection procedure:

1. In preparation for sampling utilizing a drill rig, field personnel must complete the following activities:
 - Ensure that all subsurface drilling activities are preceded by a utility clearance for the area to be investigated. This includes activities described in SOP HS-1.0, Utility Location and Excavation Clearance, as well as any location-specific procedures that may apply.

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REMEMBER

If you are digging near a marked utility (within the diameter of an underground utility that has been marked plus 18 inches), you must first locate the utility through vacuum extraction or hand digging to ensure that your activities will not damage the utility.

- Complete an Equipment Inspection Checklist for the drill rig or direct-push technology (DPT) rig. This checklist will be provided in the HASP.
 - Review the Safe Work Permit prior to conducting the activity.
 - Review the activity to be conducted.
2. Remove all surface debris (e.g., vegetation, roots, twigs, etc.) from the specific sampling location and drill and/or clean out the borehole to the desired sampling depth. Be careful to minimize potential disturbance of the material to be sampled. In saturated material, withdraw the drill bit slowly to prevent loosening of the soil around the borehole and to maintain the water level in the hole at or above groundwater level.

CAUTION

The use of bottom-discharge bits or jetting through an open-tube sampler to clean out the borehole shall not be allowed. Only the use of side-discharge bits is permitted.

3. Determine whether a stationary piston-type sampler is required to limit sample disturbance and aid in retaining the sample. Either the hydraulically operated or control rod activated-type of stationary piston sampler may be used.
4. Prior to inserting the tube sampler into the borehole, check to ensure that the sampler head contains a check valve. The check valve is necessary to keep water in the rods from pushing the sample out the tube sampler during sample withdrawal. In addition, the check valve maintains a positive suction within the tube to help retain the sample.
5. A stainless steel tube sampler is typically used to minimize chemical reaction between the sample and the sampling tube.
6. With the sampling tube resting on the bottom of the hole and the water level in the boring at groundwater level or above, push the tube into the soil with a continuous and rapid motion, without impacting or twisting. If the soil is too hard to penetrate by pushing alone, careful hammering may be used by minimizing drop distance (tapping) of the hammer. Before pulling the tube, turn it at least one revolution to shear the sample off at the bottom. In no case shall the tube be pushed farther than the length provided for the soil sample. Allow about 3 inches in the tube for cuttings and sludge.
7. Upon removal of the sampling tube from the hole, measure the length of sample in the tube and also the length penetrated.
8. Remove disturbed material in the upper end of the tube and measure the length of sample again.
9. After removing at least 1 inch of soil from the lower end, place enough packing material (clean inert material such as paper or cloth) tightly in each end of the Shelby tube and then pour melted wax into each end to make at least a ½-inch wax plug and then add more packing material to fill the voids at both ends.

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10. Place plastic caps on the ends, tape the caps in place, and dip the ends in wax to prevent loss of soil.
11. Affix label(s) to the tube as required and record sample number, depth, penetration, and recovery length on the label.
12. Mark the "up" direction on the side and upper end of the tube with indelible ink.
13. Complete a chain-of-custody form (see SOP SA-6.3) and other required forms (including Attachment A of this SOP).
14. Ship samples protected with suitable resilient packing material to reduce shock, vibration, and disturbance.

CAUTION

To preserve sample integrity do not allow tubes to freeze, and store the samples vertically with the same orientation they had in the ground, (i.e., top of sample is up) in a cool place out of the sun at all times.

CAUTION

A primary concern in the preparation of the wax plugs is the potential for the heat source and melted wax to cause a fire and/or burns. Follow the directions below to prevent injury or fire.

Electrical Heating

Using hot plates to melt the wax is acceptable. In an outdoor setting, make sure a Ground Fault Circuit Interrupter (GFCI) is employed within the electrical circuit. If a portable generator is used, ensure that the generator is an adequate distance from the sampling operation (at least 50 feet). Ensure that the extension cord is rated for the intended load and for outdoor use and is free from recognizable damage. Ensure flammable preservatives are not employed or stored near the hot plate. Although a Hot Work Permit is not required, scene safety evaluation by site personnel of the above elements is. As always, if a fire potential exists, the provisions for extinguishing must be immediately accessible as well as any provisions for first aid measures.

Open Flame

If an open flame is used, the following provisions are necessary:

- Complete a Hot Work Permit and any local permit required for elevated temperature applications. The Hot Work Permit, provided in your HASP, will aid the FOL and/or the SSO in ensuring that fire protection provisions (extinguishers, fire watches, etc.) are in place as well as ensuring that local requirements have been addressed.
- Ensure that water is available to address any wax splashes or contact. If possible, immerse the contacted area. Where this is not possible, run water over the area and apply cold compresses. The need for medical attention or first aid shall be determined on site under the direction of the SSO.

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6.3 Surface Soil Sampling

The simplest, most direct method of collecting surface soil samples for subsequent analysis is by use of a stainless steel shovel, hand auger, soil corer, or stainless steel or disposable plastic trowel.

NOTE

Multiple depth intervals are used to describe surface soil. Sometimes surface soil is defined as soil from 0 to 2 inches below ground surface (bgs), and sometimes it is defined as soil from other depths such as 0 to 2 feet bgs. Ensure that the definition of surface soil depth is clear before collecting surface soil samples.

For the purposes of instruction, the terms "surface soil" and "near-surface soil" are used in this SOP as follows:

- Surface soil - 0 to 6 inches bgs
- Near-surface soil - 6 to 18 inches bgs

If these intervals are defined differently in the planning documents, substitute the appropriate depth ranges.

In general, the following equipment is necessary for obtaining surface soil samples:

- Stainless steel or pre-cleaned disposable trowel.
- Stainless steel hand auger, soil corer, or shovel.
- Real-time air monitoring instrument (e.g., PID, FID) as directed in project planning document.
- Required PPE.
 - Nitrile surgeon's or latex gloves may be used, layered as necessary.
 - Safety glasses
 - Other – Items identified on the Safe Work Permit may be required based on location-specific requirements such as hearing protection, steel-toed work boots, and a hard hat when working near a drill rig. These provisions will be listed in the HASP or directed by the FOL and/or SSO.

Safety Reminder

The use of latex products may elicit an allergic reaction in some people. Should this occur, remove the latex gloves, treat for an allergic reaction, and seek medical attention as necessary.

- Required paperwork (see SOP SA-6.3 and Attachment A of this SOP)
- Required decontamination equipment
- Required sample container(s)
- Wooden stakes or pin flags

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- Sealable polyethylene bags (e.g., Ziploc® baggies)
- Heavy duty cooler
- Ice
- Chain-of-custody records and custody seals

When acquiring surface soil samples, use the following procedure:

1. Place padding or use knee pads when kneeling near the sample location. If necessary, place plastic sheeting to provide a clean surface for sample equipment to avoid possible cross- contamination.
2. Carefully remove vegetation, roots, twigs, litter, etc. to expose an adequate soil surface area to accommodate sample volume requirements.
3. Using a precleaned syringe or EnCore™ samplers, follow the procedure in Section 6.2.1 for collecting surface soil samples for volatile analysis. Surface soil samples for volatile organic analysis should be collected deeper than 6 inches bgs because shallower material has usually lost most of the volatiles through evaporation. Ensure that the appropriate surface soil depth is being analyzed in accordance with the planning document.
4. Using decontaminated sampling tools, thoroughly mix in place a sufficient amount of soil to fill the remaining sample containers. See Section 6.5 of this procedure for hand auger instruction, as needed.
5. Transfer the sample into those containers utilizing a stainless steel trowel.
6. Cap and securely tighten all sample containers.
7. Affix a sample label to each container. Be sure to fill out each label carefully and clearly, addressing all the categories described in SOP SA-6.3.
8. Proceed with the handling and processing of each sample container as described in SOP SA-6.2.
9. Site restoration – Whenever removing sample materials, always restore the surface. It is our intent to leave the area better than we found it. Do NOT create trip hazards in areas when pedestrian traffic may exist.

6.4 Near-Surface Soil Sampling

Collection of samples from near the surface (depth of 6 to 18 inches) can be accomplished with tools such as shovels, hand auger, soil corers, and stainless steel or pre-cleaned disposable trowels and the equipment listed under Section 6.5 of this procedure.

To obtain near-surface soil samples, the following protocol shall be used:

1. With a clean shovel, make a series of vertical cuts in the soil to the depth required to form a square approximately 1 foot by 1 foot.
2. Lever out the formed plug and scrape the bottom of the freshly dug hole with a decontaminated stainless steel or pre-cleaned disposable trowel to remove any loose soil.

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3. Follow steps 1 through 9 of Section 6.3.

6.5 Subsurface Soil Sampling With a Hand Auger

A hand augering system generally consists of a variety of stainless steel bucket bits (approximately 6.5 inches long and 2, 2.75, 3.25, and 4 inches in diameter), series of extension rods (available in 2-, 3-, 4- and 5-inch lengths), and a T-handle connected to extension rods and to the auger bucket. A larger-diameter bucket bit is commonly used to bore a hole to the desired sampling depth and then it is withdrawn. The larger-diameter bit is then replaced with a smaller-diameter bit, lowered down the hole, and slowly turned into the soil to the completion depth (approximately 6 inches). The apparatus is then withdrawn and the soil sample collected.

The hand auger can be used in a wide variety of soil conditions. It can be used to sample soil either from the surface, or to depths in excess of 12 feet. However, the presence of subsurface rocks and landfill material and collapse of the borehole normally limit sampling depth.

To accomplish soil sampling using a hand augering system, the following equipment is required:

- Complete hand auger assembly (variety of bucket bit sizes)
- Stainless steel mixing bowls
- The equipment listed in Section 6.3
- Miscellaneous hand tools as required to assemble and disassemble the hand auger units

CAUTION

Potential hazards associated with hand augering include:

- Muscle strain and sprain due to over twisting and/or over compromising yourself.
- Equipment failure due to excessive stress on the T-handle or rods through twisting. Failure of any of these components will result in a sudden release and potential injury due to that failure.

As in all situations, any intrusive activities that could damage underground utilities shall be preceded by a Dig/Excavation permit/ticket. Call the Utility Locating service in the area or your Project Health and Safety Officer for more information. When in doubt – **Get the Ticket!**

To obtain soil samples using a hand auger, use the following procedure:

1. Wearing designated PPE, attach a properly decontaminated bucket bit to a clean extension rod and attach the T-handle to the extension rod.
2. Clear the area to be sampled of any surface debris (vegetation, twigs, rocks, litter, etc.).
3. Twist the bucket into the ground while pushing vertically downward on the auger. The cutting shoes fill the bucket as it is advanced into the ground.
4. As the auger bucket fills with soil, periodically remove any unneeded soil.

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5. Add rod extensions as necessary to extend the reach of the auger. Also, note (in a field notebook, boring log, and/or on a standardized data sheet) any changes in the color, texture or odor of the soil as a function of depth. The project-specific planning document (SAP, HASP, etc.) describe requirements for scanning the soil with a real-time air monitoring instrument (e.g., PID, FID, etc.) and recording the measurements.
6. After reaching the desired depth (e.g., the top of the interval to be sampled), slowly and carefully withdraw the apparatus from the borehole to prevent or minimize movement of soil from shallower intervals to the bottom of the hole.
7. Remove the soiled bucket bit from the rod extension and replace it with another properly decontaminated bucket bit. The bucket bit used for sampling is to be smaller in diameter than the bucket bit employed to initiate the borehole.
8. Carefully lower the apparatus down the borehole. Care must be taken to avoid scraping the borehole sides.
9. Slowly turn the apparatus until the bucket bit is advanced approximately 6 inches.
10. Discard the top of the core (approximately 1 inch), which represents any loose material collected by the bucket bit before penetrating the sample material.
11. Using a precleaned syringe or EnCore™ samplers, follow the procedure in Section 6.2.1 for collecting a soil sample for volatile compound analysis directly from the bucket bit.
12. Utilizing a properly decontaminated stainless steel trowel or dedicated disposable trowel, remove the remaining sample material from the bucket bit and place into a properly decontaminated stainless steel mixing bowl.
13. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers. Refer to Section 6.2.2.
14. Follow steps 4 through 7 listed in Section 6.3.

6.5.1 Sampling Using Stainless Steel Soil Corers

A soil corer is a stainless steel tube equipped with a cutting shoe and sample window in the side. The soil corer is advanced into the soil by applying downward pressure (body weight). The soil is unloaded by then forcing a ram towards the cutting shoe, which results in the discharge of the soil core through a window in the sleeve.

Use, application, and sample protocol is the same as for hand augering provided above, but without necessarily rotating the corer while advancing it.

SAFETY REMINDER

Hand augering and soil corer sampling can be physically demanding based on the type of geology and subsurface encumbrances encountered. Soil coring has some added hazards such the corer collapsing under your weight. To reduce the potential for muscle strain and damage, the following measures will be incorporated:

- Stretch and limber your muscles before heavy exertion. This hazard becomes more predominant in the early morning hours (prior to muscles becoming limber) and later in the day (as a result of fatigue).

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- Job rotation – Share the duties so that repetitive actions do not result in fatigue and injury.
- Increase break frequencies as needed, especially as ambient conditions of heat and/or cold stress may dictate.
- Do not force the hand tools or use cheater pipes or similar devices to bypass an obstruction. Move to another location near the sampling point. Exerting additional forces on the sampling devices can result in damage and/or failure that could potentially injure someone in the immediate vicinity.
- Do not over compromise yourself when applying force to the soil corer or hand auger. If there is a sudden release, it could result in a fall or muscle injury due to strain.

6.6 Subsurface Soil Sampling with a Split-Barrel Sampler

A split-barrel (split-spoon) sampler consists of a heavy carbon steel or stainless steel sampling tube that can be split into two equal halves to reveal the soil sample (see Attachment B). A drive head is attached to the upper end of the tube and serves as a point of attachment for the drill rod. A removable tapered nosepiece/drive shoe attaches to the lower end of the tube and facilitates cutting. A basket-like sample retainer can be fitted to the lower end of the split tube to hold loose, dry soil samples in the tube when the sampler is removed from the drill hole. This split-barrel sampler is made to be attached to a drill rod and forced into the ground by means of a 140-pound or larger casing driver.

Safety Reminder

It is intended through the Equipment Inspection for Drill Rigs form provided in the HASP that the hammer and hemp rope, where applicable, associated with this activity will be inspected (no physical damage is obvious), properly attached to the hammer (suitable knots or sufficient mechanical devices), and is in overall good condition.

Split-barrel samplers are used to collect soil samples from a wide variety of soil types and from depths greater than those attainable with other soil sampling equipment.

The following equipment is used for obtaining split-barrel samples:

- Drilling equipment (provided by subcontractor).
- Split-barrel samplers (2-inch OD, 1-3/8-inch ID, either 20 inches or 26 inches long); Larger OD samplers are available if a larger volume of sample is needed.
- Drive weight assembly, 140-pound weight, driving head, and guide permitting free fall of 30 inches.
- Stainless steel mixing bowls.
- Equipment listed in Section 6.3.

The following steps shall be followed to obtain split-barrel samples (Steps 1 through 4 are typically performed by the drilling subcontractor):

1. Attach the split-barrel sampler to the sampling rods.

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2. Lower the sampler into the borehole inside the hollow stem auger bits.
3. Advance the split-barrel sampler by hammering the length (typically 18 or 24 inches) of the split-barrel sampler into the soil using 140-pound or larger hammer.
4. When the desired depth is achieved, extract the drill rods and sampler from the augers and/or borehole.
5. Detach the sampler from the drill rods.
6. Place the sampler securely in a vise so it can be opened using pipe wrenches.

CAUTION

Pipe wrenches are used to separate the split spoon into several components. The driller's helper should not apply excessive force through the use of cheater pipes or push or pull in the direction where, if the wrench slips, hands or fingers will be trapped against an immovable object.

7. Remove the drive head and nosepiece with the wrenches, and open the sampler to reveal the soil sample.
8. Immediately scan the sample core with a real-time air monitoring instrument (e.g., FID, PID, etc.) (as project-specific planning documents dictate). Carefully separate (or cut) the soil core, with a decontaminated stainless steel knife or trowel, at about 6-inch intervals while scanning the center of the core for elevated readings. Also scan stained soil, soil lenses, and anomalies (if present), and record readings.
9. If elevated vapor readings were observed, collect the sample scheduled for volatile analysis from the center of the core where elevated readings occurred. If no elevated readings were encountered, the sample material should be collected from the core's center (this area represents the least disturbed area with minimal atmospheric contact) (refer to Section 6.2.1).
10. Using the same trowel, remove remaining sample material from the split-barrel sampler (except for the small portion of disturbed soil usually found at the top of the core sample) and place the soil into a decontaminated stainless steel mixing bowl.
11. Homogenize the sample material as thoroughly as practicable then fill the remaining sample containers (refer to Section 6.2.2).
12. Follow steps 4 through 7 in Section 6.3.

6.7 Subsurface Soil Sampling Using Direct-Push Technology

Subsurface soil samples can be collected to depths of 40+ feet using DPT. DPT equipment, responsibilities, and procedures are described in SOP SA-2.5.

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6.8 **Excavation and Sampling of Test Pits and Trenches**

6.8.1 **Applicability**

This subsection presents routine test pit or trench excavation techniques and specialized techniques that are applicable under certain conditions.

CAUTION

During the excavation of trenches or pits at hazardous waste sites, several health and safety concerns arise from the method of excavation. No personnel shall enter any test pit or excavation over 4 feet deep except as a last resort, and then only under direct supervision of a Competent Person (as defined in 29 CFR 1929.650 of Subpart P - Excavations). Whenever possible, all required chemical and lithological samples should be collected using the excavator bucket or other remote sampling apparatus. If entrance is required, all test pits or excavations must be stabilized by bracing the pit sides using specifically designed wooden, steel, or aluminum support structures or through sloping and benching. Personnel entering the excavation may be exposed to toxic or explosive gases and oxygen-deficient environments; therefore, monitoring will be conducted by the Competent Person to determine if it is safe to enter. Any entry into a trench greater than 4 feet deep will constitute a Confined Space Entry and must be conducted in conformance with OSHA standard 29 CFR 1910.146. In all cases involving entry, substantial air monitoring, before entry, appropriate respiratory gear and protective clothing determination, and rescue provisions are mandatory. There must be at least three people present at the immediate site before entry by one of the field team members. This minimum number of people will increase based on the potential hazards or complexity of the work to be performed. The reader shall refer to OSHA regulations 29 CFR 1926.650, 29 CFR 1910.120, 29 CFR 1910.134, and 29 CFR 1910.146. High-hazard entries such as this will be supported by members of the Health Sciences Group professionally trained in these activities.

Excavations are generally not practical where a depth of more than about 15 to 20-feet is desired, and they are usually limited to a few feet below the water table. In some cases, a pumping system may be required to control water levels within the pit, providing that pumped water can be adequately stored or disposed. If soil data at depths greater than 15-feet are required, the data are usually obtained through test borings instead of test pits.

In addition, hazardous wastes may be brought to the surface by excavation equipment. This material, whether removed from the site or returned to the subsurface, must be properly handled according to any and all applicable federal, state, and local regulations.

6.8.2 **Test Pit and Trench Excavation**

Test pits or trench excavations are constructed with the intent that they will provide an open view of subsurface lithology and/or disposal conditions that a boring will not provide. These procedures describe the methods for excavating and logging test pits and trenches installed to determine subsurface soil and rock conditions. Test pit operations shall be logged and documented (see Attachment C).

Test pits and trenches may be excavated by hand or power equipment to permit detailed descriptions of the nature and contamination of the in-situ materials. The size of the excavation will depend primarily on the following:

- The purpose and extent of the exploration

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- The space required for efficient excavation
- The chemicals of concern
- The economics and efficiency of available equipment

Test pits normally have a cross section that is 4 to 10 feet square; test trenches are usually 3 to 6 feet wide and may be extended for any length required to reveal conditions along a specific line. The following table provides guidelines for design consideration based on equipment efficiencies.

Equipment	Typical Widths, in Feet
Trenching machine	0.25 to 1.0
Backhoe/Track Hoe	2 to 6

The lateral limits of excavation of trenches and the position of test pits shall be carefully marked on area base maps. If precise positioning is required to indicate the location of highly hazardous materials, nearby utilities, or dangerous conditions, the limits of the excavation shall be surveyed. Also, if precise determination of the depth of buried materials is needed for design or environmental assessment purposes, the elevation of the ground surface at the test pit or trench location shall also be determined by survey. If the test pit/trench will not be surveyed immediately, it shall be backfilled and its position identified with stakes placed in the ground at the margin of the excavation for later surveying.

The construction of test pits and trenches shall be planned and designed in advance as much as possible. However, the following field conditions may necessitate revisions to the initial plans:

- Subsurface utilities
- Surface and subsurface encumbrances
- Vehicle and pedestrian traffic patterns
- Purpose for excavation (e.g., the excavation of potential ordnance items)

The final depth and construction method shall be collectively determined by the FOL and designated Competent Person. The actual layout of each test pit, temporary staging area, and spoils pile may further be predicated based on site conditions and wind direction at the time the test pit is excavated. Prior to excavation, the area may be surveyed by magnetometer or metal detector or other passive methods specified in SOP HS1.0, Utility Location and Excavation Clearance, to identify the presence of underground utilities or drums. Where possible, the excavator should be positioned upwind and preferably within an enclosed cab.

No personnel shall enter any test pit or excavation except as a last resort, and then only under direct supervision of a Competent Person. If entrance is required, OSHA requirements must be met (e.g., walls must be braced with wooden or steel braces, ladders must be placed for every 25 feet of lateral travel and extended 3 feet above ground surface). A temporary guard rail or vehicle stop must be placed along the surface of the hole before entry in situations where the excavation may be approached by traffic. Spoils will be stockpiled no closer than 2 feet from the sidewall of the excavation. The excavation equipment operator shall be careful not to undercut sidewalls and will, where necessary, bench back to increase stability. The top cover, when considered clean, will be placed separately from the subsurface materials to permit clean cover. It is emphasized that the project data needs should be structured such that required samples can be collected without requiring entrance into the excavation. For example,

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samples of leachate, groundwater, or sidewall soil can be collected with telescoping poles or similar equipment.

Dewatering and watering may be required to ensure the stability of the side walls, to prevent the bottom of the pit from heaving, and to keep the excavation stable. This is an important consideration for excavations in cohesionless material below the groundwater table and for excavations left open greater than a day. Liquids removed as a result of dewatering operations must be handled as potentially contaminated materials. Procedures for the collection and disposal of such materials should be discussed in the site-specific project plans.

Where possible excavations and test pits shall be opened and closed within the same working day. Where this is not possible, the following engineering controls shall be put in place to control access:

- Trench covers/street plates
- Fences encompassing the entire excavation intended to control access
- Warning signs warning personnel of the hazards
- Amber flashing lights to demarcate boundaries of the excavation at night

Excavations left open will have emergency means to exit should someone accidentally enter.

6.8.3 Sampling in Test Pits and Trenches

6.8.3.1 General

Log test pits and trenches as they are excavated in accordance with the Test Pit Log presented in Attachment C. These records include plan and profile sketches of the test pit/trench showing materials encountered, their depth and distribution in the pit/trench, and sample locations. These records also include safety and sample screening information.

Entry of test pits by personnel is extremely dangerous, shall be avoided unless absolutely necessary, and can occur only after all applicable health and safety and OSHA requirements have been met as stated above. These provisions will be reiterated as appropriate in the project-specific HASP.

The final depth and type of samples obtained from each test pit will be determined at the time the test pit is excavated. Sufficient samples are usually obtained and analyzed to quantify contaminant distribution as a function of depth for each test pit. Additional samples of each waste phase and any fluids encountered in each test pit may also be collected.

In some cases, samples of soil may be extracted from the test pit for reasons other than waste sampling and chemical analysis, for instance, to obtain geotechnical information. Such information includes soil types, stratigraphy, strength, etc., and could therefore entail the collection of disturbed (grab or bulk) or relatively undisturbed (hand-carved or pushed/driven) samples that can be tested for geotechnical properties. The purposes of such explorations are very similar to those of shallow exploratory or test borings, but often test pits offer a faster, more cost-effective method of sampling than installing borings.

6.8.3.2 Sampling Equipment

The following equipment is needed for obtaining samples for chemical or geotechnical analysis from test pits and trenches:

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- Backhoe or other excavating machinery.
- Shovels, picks, hand augers, and stainless steel trowels/disposable trowels.
- Sample container - bucket with locking lid for large samples; appropriate bottle ware for chemical or geotechnical analysis samples.
- Polyethylene bags for enclosing sample containers; buckets.
- Remote sampler consisting of 10-foot sections of steel conduit (1-inch-diameter), hose clamps, and right angle adapter for conduit (see Attachment D).

6.8.3.3 Sampling Methods

The methods discussed in this section refer to test pit sampling from grade level. If test pit entry is required, see Section 6.8.3.4.

- Excavate the trench or pit in several 0.5- to 1.0-foot depth increments. Where soil types support the use of a sand bar cutting plate, use of this device is recommended to avoid potentially snagging utilities with the excavator teeth. It is recommended that soil probes or similar devices be employed where buried items or utilities may be encountered. This permits the trench floor to be probed prior to the next cut.
- After each increment:
 - the operator shall wait while the sampler inspects the test pit from grade level
 - the sampler shall probe the next interval where this is considered necessary. Practical depth increments for lithological evaluations may range from 2 to 4 feet or where lithological changes are noted.
- The backhoe operator, who will have the best view of the test pit, shall immediately cease digging if:
 - Any fluid phase, including groundwater seepage, is encountered in the test pit
 - Any drums, other potential waste containers, obstructions, or utility lines are encountered
 - Distinct changes of material being excavated are encountered

This action is necessary to permit proper sampling of the test pit and to prevent a breach of safety protocol. Depending on the conditions encountered, it may be required to excavate more slowly and carefully with the backhoe.

For obtaining test pit samples from grade level, the following procedure shall be followed:

- Use the backhoe to remove loose material from the excavation walls and floor to the greatest extent possible.
- Secure the walls of the pit, if necessary. (There is seldom any need to enter a pit or trench that would justify the expense of shoring the walls. All observations and samples should be taken from the ground surface.)

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- Samples of the test pit material are to be obtained either directly from the backhoe bucket or from the material after it has been deposited on the ground, as follows:
 - a. The sampler or FOL shall direct the backhoe operator to remove material from the selected depth or location within the test pit/trench.
 - b. The backhoe operator shall bring the bucket over to a designated location on the sidewall a sufficient distance from the pit (at least 5 feet) to allow the sampler to work around the bucket.
 - c. After the bucket has been set on the ground, the backhoe operator shall either disengage the controls or shut the machine down.
 - d. When signaled by the operator that it is safe to do, the sampler will approach the bucket.
 - e. The soil shall be monitored with a photoionization or flame ionization detector (PID or FID) as directed in the project -specific planning documents.
 - f. The sampler shall collect the sample from the center of the bucket or pile in accordance with surface soil sampling procedures of Section 6.3 or 6.4, as applicable. Collecting samples from the center of a pile or bucket eliminates cross-contamination from the bucket or other depth intervals.
- If a composite sample is desired, several depths or locations within the pit/trench will be selected, and the bucket will be filled from each area. It is preferable to send individual sample bottles filled from each bucket to the laboratory for compositing under the more controlled laboratory conditions. However, if compositing in the field is required, each sample container shall be filled from materials that have been transferred into a mixing bucket and homogenized. Note that homogenization/compositing is not applicable for samples to be subjected to volatile organic analysis.

CAUTION

Care must be exercised when using the remote sampler described in the next step because of potential instability of trench walls. In situations where someone must move closer than 2 feet to the excavation edge, a board or platform should be used to displace the sampler's weight to minimize the chance of collapse of the excavation edge. Fall protection should also be employed when working near the edges or trenches greater than 6 feet deep. An immediate means to extract people who have fallen into the trench will be immediately available. These means may include ladders or rope anchor points.

- Using the remote sampler shown in Attachment D, samples can be taken at the desired depth from the sidewall or bottom of the pit as follows:
 - a. Scrape the face of the pit/trench using a long-handled shovel or hoe to remove the smeared zone that has contacted the backhoe bucket.
 - b. Collect the sample directly into the sample jar, by scraping with the jar edge, eliminating the need for sample handling equipment and minimizing the likelihood of cross-contamination.
 - c. Cap the sample jar, remove it from the remote sampler assembly, and package the sample for shipment in accordance with SOP SA-6.3.
- Complete documentation as described in SOP SA-6.3 and Attachment C of this SOP.

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6.8.3.4 In-Pit Sampling

Under rare conditions, personnel may be required to enter the test pit/trench. This is necessary only when soil conditions preclude obtaining suitable samples from the backhoe bucket (e.g., excessive mixing of soil or wastes within the test pit/trench) or when samples from relatively small discrete zones within the test pit are required. This approach may also be necessary to sample any seepage occurring at discrete levels or zones in the test pit that are not accessible with remote samplers.

In general, personnel shall sample and log pits and trenches from the ground surface, except as provided for by the following criteria:

- There are no practical alternative means of obtaining such data.
- The SSO and Competent Person determine that such action can be accomplished without breaching site safety protocol. This determination will be based on actual monitoring of the pit/trench after it is dug (including, at a minimum, measurements of oxygen concentration, flammable gases, and toxic compounds, in that order). Action levels will be provided in project-specific planning documents.
- A company-designated Competent Person determines that the pit/trench is stable through soil classification evaluation/inspections or is made stable (by cutting/grading the sidewalls or using shoring) prior to entrance of any personnel. OSHA requirements shall be strictly observed.

If these conditions are satisfied, only one person may enter the pit/trench. On potentially hazardous waste sites, this individual shall be dressed in selected PPE as required by the conditions in the pit. He/she shall be affixed to a harness and lifeline and continuously monitored while in the pit.

A second and possible third individual shall be fully dressed in protective clothing including a self-contained breathing device and on standby during all pit entry operations to support self rescue or assisted self rescue. The individual entering the pit shall remain therein for as brief a period as practical, commensurate with performance of his/her work. After removing the smeared zone, samples shall be obtained with a decontaminated trowel or spoon.

6.8.3.5 Geotechnical Sampling

In addition to the equipment described in Section 6.8.3.2, the following equipment is needed for geotechnical sampling:

- Soil sampling equipment, similar to that used in shallow drilled boring (i.e., thin-walled tube samplers), that can be pushed or driven into the floor of the test pit.
- Suitable driving (e.g., sledge hammer) or pushing (e.g., backhoe bucket) equipment used to advance the sampler into the soil.
- Knives, spatulas, and other suitable devices for trimming hand-carved samples.
- Suitable containers (bags, jars, tubes, boxes, etc.), labels, wax, etc. for holding and safely transporting collected soil samples.
- Geotechnical equipment (pocket penetrometer, torvane, etc.) for field testing collected soil samples for classification and strength properties.

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Disturbed grab or bulk geotechnical soil samples may be collected for most soil in the same manner as comparable soil samples for chemical analysis. These collected samples may be stored in jars or plastic-lined sacks (larger samples), which will preserve their moisture content. Smaller samples of this type are usually tested for their index properties to aid in soil identification and classification: larger bulk samples are usually required to perform compaction tests.

Relatively undisturbed samples are usually extracted in cohesive soil using thin-walled tube samplers, and such samples are then tested in a geotechnical laboratory for their strength, permeability, and/or compressibility. The techniques for extracting and preserving such samples are similar to those used in performing Shelby tube sampling in borings, except that the sampler is advanced by hand or backhoe, rather than by a drill rig. Also, the sampler may be extracted from the test pit by excavation around the tube when it is difficult to pull it out of the ground. If this excavation requires entry of the test pit, the requirements described in Section 6.8.3.4 shall be followed. The thin-walled tube sampler shall be pushed or driven vertically into the floor or steps excavated in the test pit at the desired sampling elevations. Extracting tube samples horizontally from the walls of the test pit is not appropriate because the sample will not have the correct orientation.

A sledge hammer or backhoe may be used to drive or push the tube into the ground. Place a piece of wood over the top of the sampler or sampling tube to prevent damage during driving/pushing of the sample. Pushing the sampler with a constant thrust is always preferable to driving it with repeated blows, thus minimizing disturbance to the sample. When using a sledge hammer, it is recommended that the sampler be stabilized using a rope/strap wrench or pipe wrench to remove the person's hands holding the sampler from the strike zone. If the sample cannot be extracted by rotating it at least two revolutions (to shear off the sample at the bottom), hook the sampler to the excavator or backhoe and extract. This means an alternative head will be used as a connection point or that multiple choke hitches will be applied to extract the sampler. If this fails and the excavator can dig deeper without potentially impacting subsurface utilities, excavate the sampler. If this fails or if the excavator cannot be used due to subsurface utilities, hand-excavate to remove the soil from around the sides of the sampler. If hand-excavation requires entry into the test pit, the requirements in Section 6.8.3.4 must be followed. Prepare the sample as described in Steps 9 through 13 in Section 6.2.3, and label, pack and transport the sample in the required manner, as described in SOPs SA-6.3 and SA-6.1.

6.8.4 Backfilling of Trenches and Test Pits

All test pits and excavations must be either backfilled, covered, or otherwise protected at the end of each day. No excavations shall remain open during non-working hours unless adequately covered or otherwise protected.

Before backfilling, the onsite crew may photograph, if required by the project-specific work plan, all significant features exposed by the test pit and trench and shall include in the photograph a scale to show dimensions. Photographs of test pits shall be marked to include site number, test pit number, depth, description of feature, and date of photograph. In addition, a geologic description of each photograph shall be entered in the site logbook. All photographs shall be indexed and maintained as part of the project file for future reference.

After inspection, backfill material shall be returned to the pit under the direction of the FOL. Backfill should be returned to the trench or test pit in 6-inch to 1-foot lifts and compacted with the bucket. Remote controlled tampers or rollers may be lowered into the trench and operated from top side. This procedure will continue to the grade surface. It is recommended that the trench be tracked or rolled in. During excavation, clean soil from the top 2 feet may have been separated to be used to cover the last segments. Where these materials are not clean, it is recommended that clean fill be used for the top cover.

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If a low-permeability layer is penetrated (resulting in groundwater flow from an upper contaminated flow zone into a lower uncontaminated flow zone), backfill material must represent original conditions or be impermeable. Backfill could consist of a soil-bentonite mix prepared in a proportion specified by the FOL (representing a permeability equal to or less than original conditions). Backfill can be covered by "clean" soil and graded to the original land contour. Revegetation of the disturbed area may also be required.

6.9 Records

The appropriate sample log sheet (see Attachment A of this SOP) must be completed by the site geologist/sampler for all samples collected. All soil sampling locations should be documented by tying in the location of two or more nearby permanent landmarks (building, telephone pole, fence, etc.) or obtaining GPS coordinates; and shall be noted on the appropriate sample log sheet, site map, or field notebook. Surveying may also be necessary, depending on the project requirements.

Test pit logs (see Attachment C of this SOP) shall contain a sketch of pit conditions. If the project-specific work plan requires photographs, at least one photograph with a scale for comparison shall be taken of each pit. Included in the photograph shall be a card showing the test pit number. Boreholes, test pits, and trenches shall be logged by the field geologist in accordance with SOP GH-1.5.

Other data to be recorded in the field logbook include the following:

- Name and location of job
- Date of boring and excavation
- Approximate surface elevation
- Total depth of boring and excavation
- Dimensions of pit
- Method of sample acquisition
- Type and size of samples
- Soil and rock descriptions
- Photographs if required
- Groundwater levels
- PID/FID/LEL/O₂ meter readings
- Other pertinent information, such as waste material encountered

In addition, site-specific documentation to be maintained by the SSO and/or Competent Person will be required including:

- Calibration logs
- Excavation inspection checklists

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- Soil type classification

7.0 REFERENCES

American Society for Testing and Materials, 1987. ASTM Standards D1587-83 and D1586-84. ASTM Annual Book of Standards. ASTM. Philadelphia, Pennsylvania. Volume 4.08.

NUS Corporation, 1986. Hazardous Material Handling Training Manual.

NUS Corporation and CH2M Hill, August, 1987. Compendium of Field Operation Methods. Prepared for the U.S. EPA.

OSHA, Excavation, Trenching and Shoring 29 CFR 1926.650-653.

OSHA, Confined Space Entry 29 CFR 1910.146.

USEPA, November 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.

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ATTACHMENT A **SOIL & SEDIMENT SAMPLE LOG SHEET**



Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page ____ of ____

Project Site Name: _____	Sample ID No.: _____
Project No.: _____	Sample Location: _____
<input type="checkbox"/> Surface Soil	Sampled By: _____
<input type="checkbox"/> Subsurface Soil	C.O.C. No.: _____
<input type="checkbox"/> Sediment	Type of Sample:
<input type="checkbox"/> Other: _____	<input type="checkbox"/> Low Concentration
<input type="checkbox"/> QA Sample Type: _____	<input type="checkbox"/> High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

--	--

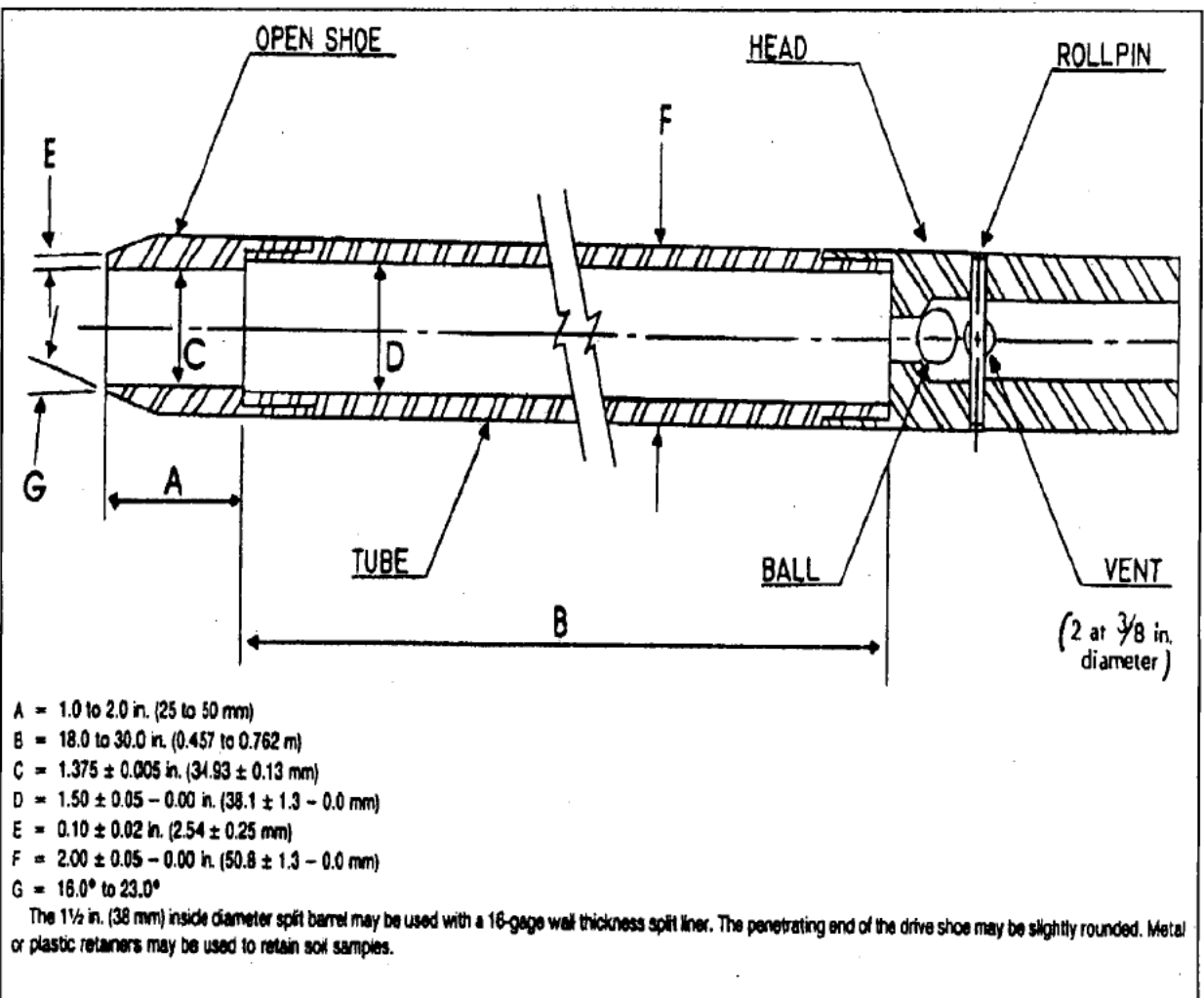
Circle if Applicable:

Signature(s):

MS/MSD	Duplicate ID No.:	Signature(s):
--------	-------------------	---------------

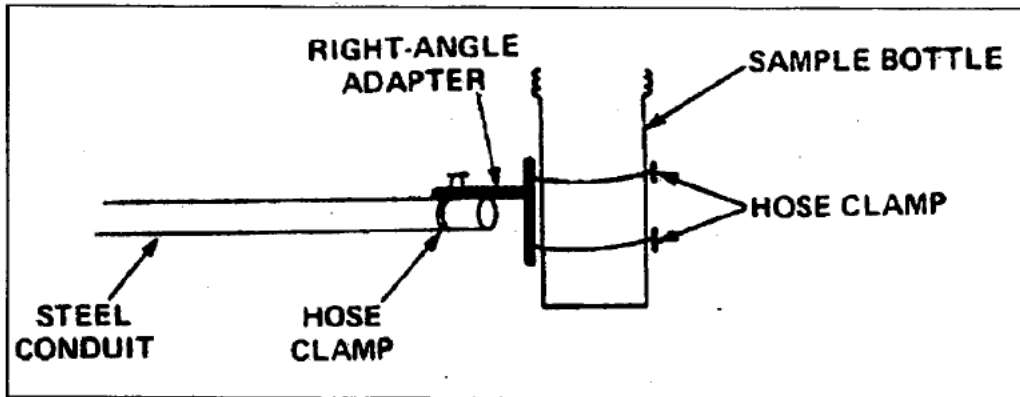
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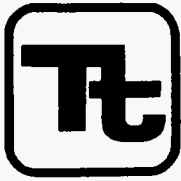
ATTACHMENT B SPLIT-SPOON SAMPLER



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**ATTACHMENT D
REMOTE SAMPLE HOLDER FOR TEST PIT/TRENCH SAMPLING**





TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

Number	SA-2.5	Page	1 of 6
Effective Date	09/03	Revision	3
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>DS</i>		

Subject DIRECT PUSH TECHNOLOGY
(GEOPROBE®/HYDROPUNCH™)

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1.0 PURPOSE

The purpose of this procedure is to provide general reference information on Direct Push Technology (DPT). DPT is designed to collect soil, groundwater, and soil gas samples without using conventional drilling techniques. The advantage of using DPT over conventional drilling includes the generation of little or no drill cuttings, sampling in locations with difficult accessibility, reduced overhead clearance requirements, no fluid introduction during probing, and typical lower costs per sample than with conventional techniques. Disadvantages include a maximum penetration depth of approximately 15 to 40 feet in dense soils (although it may be as much as 60 to 80 feet in certain types of geological environments), reduced capability of obtaining accurate water-level measurements, and the inability to install permanent groundwater monitoring wells. The methods and equipment described herein are for collection of surface and subsurface soil samples and groundwater samples. Soil gas sampling is discussed in SOP SA-2.4.

2.0 SCOPE

This procedure provides information on proper sampling equipment and techniques for DPT. Review of the information contained herein will facilitate planning of the field sampling effort by describing standard sampling techniques. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require adjustments in methodology.

3.0 GLOSSARY

Direct Push Technology (DPT) - DPT refers to sampling tools and sensors that are driven directly into the ground without the use of conventional drilling equipment. DPT typically utilizes hydraulic pressure and/or percussion hammers to advance the sampling tools. A primary advantage of DPT over conventional drilling techniques is that DPT results in the generation of little or no investigation derived waste.

Geoprobe® - Geoprobe® is a manufacturer of a hydraulically-powered, percussion/probing machines utilizing DPT to collect subsurface environmental samples. Geoprobe® relies on a relatively small amount of static weight (vehicle) combined with percussion as the energy for advancement of a tool string. The Geoprobe® equipment can be mounted in a multitude of vehicles for access to all types of environmental sites.

HydroPunch™ - HydroPunch™ is a manufacturer of stainless steel and Teflon® sampling tools that are capable of collecting representative groundwater and/or soil samples without requiring the installation of a groundwater monitoring well or conventional soil boring. HydroPunch™ is an example of DPT sampling equipment.

Flame Ionization Detector (FID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing a flame as the energizing source.

Photo Ionization Detector (PID) - A portable instrument for the measurement of many combustible organic compounds and a few inorganic compounds in air at parts-per million levels. The basis for the detection is the ionization of gaseous species utilizing ultraviolet radiation as the energizing source.

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for selecting and/or reviewing the appropriate DPT drilling procedure required to support the project objectives.

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Field Operations Leader (FOL)- The FOL is primarily responsible for performing the DPT in accordance with the project-specific plan.

5.0 SOIL SAMPLING PROCEDURES

5.1 General

The common methodology for the investigation of the vadose zone is soil boring drilling and soil sampling. However, drilling soil borings can be very expensive. Generally the advantage of DPT for subsurface soil sampling is the reduced cost of disposal of drilling cuttings and shorter sampling times.

5.2 Sampling Equipment

Equipment needed for conducting DPT drilling for subsurface soil sampling includes, but is not limited to, the following:

- Geoprobe® Sampling Kit
- Cut-resistant gloves
- 4-foot x 1.5-inch diameter macrocore sampler
- Probe sampling adapters
- Roto-hammer with 1.5-inch bit
- Disposable acetate liners for soil macrocore sampler
- Cast aluminum or steel drive points
- Geoprobe® AT-660 Series Large Bore Soil Sampler, or equivalent
- Standard decontamination equipment and solutions

For health and safety equipment and procedures, follow the direction provided in the Safe Work Permit in Attachment 1, or the more detailed directions provided in the project's Health and Safety Plan.

5.3 DPT Sampling Methodology

There are several methods for the collection of soil samples using DPT drilling. The most common method is discussed in the following section. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project-specific plan.

- Macrocore samplers fitted with detachable aluminum or steel drive points are driven into the ground using hydraulic pressure. If there is concrete or pavement over a sampling location, a Roto-hammer is used to drill a minimum 1.5-inch diameter hole through the surface material. A Roto-hammer may also be used if very dense soils are encountered.
- The sampler is advanced continuously in 4-foot intervals or less if desired. No soil cuttings are generated because the soil which is not collected in the sampler is displaced within the formation.
- The sampler is retracted from the hole, and the 4-foot continuous sample is removed from the outer coring tube. The sample is contained within an inner acetate liner.
- Attach the metal trough from the Geoprobe® Sampling Kit firmly to the tail gate of a vehicle. If a vehicle with a tail gate is not available, secure the trough on another suitable surface.
- Place the acetate liner containing the soils in the trough.

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- While wearing cut-resistant gloves (constructed of leather or other suitable material), cut the acetate liner through its entire length using the double-bladed knife that accompanies the Geoprobe® Sampling Kit. Then remove the strip of acetate from the trough to gain access to the collected soils. Do not attempt to cut the acetate liner while holding it in your hand.
- Field screen the sample with an FID or PID, and observe/examine the sample (according to SOP GH-1.3). If appropriate, transfer the sample to sample bottles for laboratory analysis. If additional volume is required, push an additional boring adjacent to the first and composite/mix the same interval. Field compositing is usually not acceptable for sample requiring volatile organics analysis.
- Once sampling has been completed, the hole is backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch is used to cap holes through paved or concrete areas. All holes should be finished smooth to existing grade.
- In the event the direct push van/truck cannot be driven to a remote location or a sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with air/electric operated equipment (e.g., jack hammer).
- Sampling equipment is decontaminated prior to collecting the next sample.

6.0 GROUNDWATER SAMPLING PROCEDURES

6.1 General

The most common methodology for the investigation of groundwater is the installation and sampling of permanent monitoring wells. If only groundwater screening is required, the installation and sampling of temporary well points may be performed. The advantage of temporary well point installation using DPT is reduced cost due to no or minimal disposal of drilling cuttings and well construction materials, and shorter installation/times sampling.

Two disadvantages of DPT drilling for well point installation are:

- In aquifers with low yields, well points may have to be sampled without purging or development.
- If volume requirements are high, this method can be time consuming for low yield aquifers.

6.2 Sampling Equipment

Equipment needed for temporary well installation and sampling using DPT includes, but is not limited, to the following:

- 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point
- Connecting rods
- Roto-hammer with 1.5-inch bit
- Mechanical jack
- 1/4-inch OD polyethylene tubing
- 3/8-inch OD polyethylene tubing
- Peristaltic pump
- Standard decontamination equipment and solutions

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6.3 DPT Temporary Well Point Installation and Sampling Methodology

There are several methods for the installation and sampling of temporary well points using DPT. The most common methodology is discussed below. Variations of the following method may be conducted upon approval of the Project Manager in accordance with the project specific plan.

- A 2-foot x 1-inch diameter mill-slotted (0.005 to 0.02-inch) well point attached to connecting rods is driven into the ground to the desired depth using a rotary electric hammer or other direct push drill rig. If there is concrete or pavement over a sampling location, a Roto-hammer or electric coring machine is used to drill a hole through the surface material.
- The well point will be allowed to equilibrate for at least 15 minutes, after which a measurement of the static water level will be taken. The initial measurement of the water level will be used to assess the amount of water which is present in the well point and to determine the amount of silt and sand infiltration that may have occurred.
- The well point will be developed using a peristaltic pump and polyethylene tubing to remove silt and sand which may have entered the well point. The well point is developed by inserting polyethylene tubing to the bottom of the well point and lifting and lowering the tubing slightly while the pump is operating. The pump will be operated at a maximum rate of approximately 2 liters per minute. After removal of sediment from the bottom of the well point, the well point will be vigorously pumped at maximum capacity until discharge water is visibly clear and no further sediments are being generated. Measurements of pH, specific conductance, temperature, and turbidity shall be recorded every 5 to 10 minutes during the purging process. After two consistent readings of pH, specific conductance, temperature and turbidity (± 10 percent), the well may be sampled.
- A sample will be collected using the peristaltic pump set at the same or reduced speed as during well development. Samples (with the exception of the samples to be analyzed for volatile organic compounds, VOCs) will be collected directly from the pump discharge. Sample containers for VOCs will be filled by (first shutting off the pump) crimping the discharge end of the sample tubing when filled, removing the inlet end of the sample tubing from the well, suspending the inlet tubing above the vial, and allowing water to fill each vial by gravity flow.
- Once the groundwater sample has been collected, the connecting rods and well point will be removed from the hole with the direct push rig hydraulics. The hole will be backfilled with bentonite chips or bentonite cement grout, depending upon project requirements. Asphalt or concrete patch will be used to cap holes through paved or concrete areas. All holes will be finished smooth to existing grade.
- In the event the direct push van/truck cannot be driven to a remote location or sampling location with difficult accessibility, sampling probes may be advanced and sampled manually or with air/electric-operated equipment (e.g., jack hammer).
- Decontaminate the equipment before moving to the next location.

7.0 RECORDS

A record of all field procedures, tests, and observations must be recorded in the field logbook, boring logs, and sample log sheets, as needed. Entries should include all pertinent data regarding the investigation. The use of sketches and field landmarks will help to supplement the investigation and evaluation.

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**ATTACHMENT 1
SAFE WORK PERMIT FOR DPT OPERATIONS**

Permit No. _____ Date: _____ Time: From _____ to _____

SECTION I: General Job Scope

- I. Work limited to the following (description, area, equipment used): **Monitoring well drilling and installation through direct push technology**
- II. Required Monitoring Instruments: _____
- III. Field Crew: _____
- IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

- V. Protective equipment required Respiratory equipment required
- | | | |
|--|--|--|
| Level D <input checked="" type="checkbox"/> Level B <input type="checkbox"/> | Full face APR <input type="checkbox"/> | Escape Pack <input type="checkbox"/> |
| Level C <input type="checkbox"/> Level A <input type="checkbox"/> | Half face APR <input type="checkbox"/> | SCBA <input type="checkbox"/> |
| Detailed on Reverse | SKA-PAC SAR <input type="checkbox"/> | Bottle Trailer <input type="checkbox"/> |
| | Skid Rig <input type="checkbox"/> | None <input checked="" type="checkbox"/> |

Level D Minimum Requirements: Sleeved shirt and long pants, safety footwear, and work gloves. Safety glasses, hard hats, and hearing protection will be worn when working near or sampling in the vicinity of the DPT rig.

Modifications/Exceptions.

- | VI. Chemicals of Concern | Action Level(s) | Response Measures |
|--------------------------|-----------------|-------------------|
| _____ | _____ | _____ |

VII. Additional Safety Equipment/Procedures

- | | |
|---|--|
| Hard-hat <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Hearing Protection (Plugs/Muffs) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Safety Glasses <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Safety belt/harness <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Chemical/splash goggles <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Radio <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No |
| Splash Shield <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | Barricades <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No |
| Splash suits/coveralls <input type="checkbox"/> Yes <input type="checkbox"/> No | Gloves (Type - _____) <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Steel toe Work shoes or boots <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No | Work/warming regimen <input type="checkbox"/> Yes <input type="checkbox"/> No |

Modifications/Exceptions: Reflective vests for high traffic areas.

- | | | | | |
|--|-------------------------------------|-------------------------------------|--------------------------|--------------------------|
| VIII. Procedure review with permit acceptors | Yes | NA | Yes | NA |
| Safety shower/eyewash (Location & Use)..... | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Daily tail gate meetings..... | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Contractor tools/equipment/PPE inspected | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Emergency alarms | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Evacuation routes | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Assembly points | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

IX. Site Preparation

- | | |
|---|--|
| Utility Clearances obtained for areas of subsurface investigation | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Physical hazards removed or blockaded | <input type="checkbox"/> Yes <input type="checkbox"/> No |
| Site control boundaries demarcated/signage | <input type="checkbox"/> Yes <input type="checkbox"/> No |

X. Equipment Preparation

- | | |
|--|---|
| Equipment drained/depressurized..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA |
| Equipment purged/cleaned..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA |
| Isolation checklist completed..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA |
| Electrical lockout required/field switch tested | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA |
| Blinds/misalignments/blocks & bleeds in place | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA |
| Hazardous materials on walls/behind liners considered..... | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> NA |

- XI. Additional Permits required (Hot work, confined space entry). ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

- XII. Special instructions, precautions:
- _____
- _____

Permit Issued by: _____ Permit Accepted by: _____



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

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Effective Date	06/99	Revision	1
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>DS</i>		

Subject

BOREHOLE AND SAMPLE LOGGING

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1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Geologist. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 Materials Needed

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCl)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

FIGURE 1 (CONTINUED)

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)											
COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Size					FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size						
FIELD IDENTIFICATION PROCEDURES (Excluding Filled or Layer Thinner Than 1 Inches and Bedding Practices on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (Excluding Filled or Layer Thinner Than 1 Inches and Bedding Practices on Estimated Weights)				GROUP SYMBOL	TYPICAL NAMES	
					Identification Procedure on Fraction Smaller than No. 40 Sieve Size						
					DILATOMETRY (Shear Compression Characteristics)		TOUGHNESS (Consistency Near Field Limit)				
GRAVELS (G) > 40% W _P > 50%	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravel, gravel-sand mixtures, etc. or no fines.	SILTS AND CLAYS (Liquid Limit < 4)	None to Slight	Out to Flow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.	
		Preferentially one size or a range of sizes with some intermediate size missing.	GP	Poorly graded gravel, gravel-sand mixtures, etc. or no fines.		Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.	
	GRAVELS WITH FINES (High % Fines)	Nonplastic fines (for identification procedures, see ML)	GM	Silty gravel, poorly graded gravel-sand mixtures.		Slight to Medium	Slow	Slight	OL	Organic silts and organic silty clays of low plasticity.	
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravel, poorly graded gravel-sand mixtures.		Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic clays of low to medium plasticity or determinative on the sandy or silty silty, elastic silts.	
SANDS (S) > 40% W _P > 50%	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sandy, etc. or no fines.	SILTS AND CLAYS (Liquid Limit > 4)	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.	
		Preferentially one size or a range of sizes with some intermediate size missing.	SP	Poorly graded sand, gravelly sandy, etc. or no fines.		Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.	
	SANDS WITH FINES (High % Fines)	Nonplastic fines (for identification procedures, see ML)	SM	Silty sand, poorly graded sand mixtures.		HIGHLY ORGANIC SOILS Readily stressed by color, odor, spongy feel and frequently by blow resistance.				PT	Peat and other organic soils.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sand, poorly graded sand-clay mixtures.							

Boundary classification: Soil possessing characteristics of two groups is designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder. All test data on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE - BLOWS/FOOT
Very Loose	< 4
Loose	4 - 9
Medium Loose	10 - 19
Dense	20 - 29
Very Dense	30 - 59

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNID. COMPRESSION STRESS (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE - BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.5	< 1 to 2	Easily penetrated several inches by RL
Soft	> 0.5 to < 1	2 to 4	Easily penetrated several inches by thumb.
Medium Soft	> 1 to < 2	4 to 9	Can be penetrated several inches by thumb.
Stiff	> 2 to < 4	> 9 to 15	Hardly indented by thumb.
Very Stiff	> 4 to < 10	> 15 to 30	Hardly indented by thumbnail.
Hard	More than 10	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Descriptive Term	Spall or other Kind of Rock	Hammer Effects	Descriptive Term	Abbreviation	Spalling
Soft	Easily chipped	Cracks when pressed with hammer	Very Broken	(V.B.)	> 4"
Medium Soft	Can be chipped	Breaks into blocky, crumbly edges	Broken	(B.)	2"-4"
Medium Hard	Can be scratched	Breaks into blocky, sharp edges	Blocky	(B.)	1"-2"
Hard	Cannot be scratched	Breaks into blocky, sharp edges	Massive	(M.)	> 1/2"

LEGEND:

SOIL SAMPLES - TYPES

- 5'-4" Split Barrel Sample
- 5' 0" - 5' 0" Undisturbed Sample
- 0 - Other Sample, Specify in Remarks

ROCK SAMPLES - TYPES

- XNO (Continuous) Core, > 1" x 0.0 D.
- ONO (Undisturbed) Core, > 1" x 0.0 D.
- Z - Other Core Size, Specify in Remarks

TEST LEVELS

- 1. 1. 1. 1. Initial Load (within 4 Depth)
- 2. 2. 2. 2. Split Load (end of hole < 4 Depth)

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5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inch Φ -1/2 inch Φ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.3. Those designations are:

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Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

FIGURE 2

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

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Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

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FIGURE 3

BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

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5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone - Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale - A fissile very fine-grained rock. Fractures along bedding planes.
- Limestone - Rock made up predominantly of calcite (CaCO_3). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal - Rock consisting mainly of organic remains.
- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

FIGURE 4**GRAIN SIZE CLASSIFICATION FOR ROCKS**

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm

After Wentworth, 1922

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5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).
- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.
- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.
- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the words "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2-inch spacing between fractures
- Broken (BR.) - 2-inch to 1-foot spacing between fractures
- Blocky (BL.) - 1- to 3-foot spacing between fractures
- Massive (M.) - 3 to 10-foot spacing between fractures

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The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD
(After Deere, 1964)

$$RQD \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

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5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inches or less), probably continuous layer.
- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."
- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."
- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."
- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.
- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.
- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.
- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.
- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite - A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

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5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C - Coarse	Lt - Light	Yl - Yellow
Med - Medium	BR - Broken	Or - Orange
F - Fine	BL - Blocky	SS - Sandstone
V - Very	M - Massive	Sh - Shale
Sl - Slight	Br - Brown	LS - Limestone
Occ - Occasional	Bl - Black	Fgr - Fine-grained
Tr - Trace		

5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.
- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.
- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.
- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.
- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.

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FIGURE 5
COMPLETED BORING LOG (EXAMPLE)



BORING LOG

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PROJECT NAME:
PROJECT NUMBER:
DRILLING COMPANY:
DRILLING RIG:

NSB-SITE

9594

SOILTEST CO.

CME-55

BORING NUMBER:

SB/MW1

DATE:

3/8/96

GEOLOGIST:

SJ CONTI

DRILLER:

R. ROCK

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS	Remarks	PID/FID Reading (ppm)			
										Sample	Sampler BZ	Borehole**	Driller BZ**
S-1 e 0800	0.0 2.0	7 6 10	1.5/2.0		M DENSE	BRN TO BLK	SILTY SAND - SOME ROCK FR. TR BRICKS (FILL)	SM	MOIST SL. ORG. ODOR FILL TO 4'±	5	0	0	0
S-2 e 0810	4.0 6.0	5 7 8	2.9/2.0	4.0	M DENSE	BRN	SILTY SAND - TR FINE GRAVEL	SM	MOIST - W ODOR NAT. MATL. TOOK SAMPLE SB01-0406 FOR ANALYSIS	10	0	-	-
S-3 e 0820	8.0 10.0	6 8 16	1.9/2.0	8.0	DENSE	TAN BRN	FINE TO COARSE SAND TR.F. GRAVEL	SW	WET HIT WATER @ 7'±	0	0	0	0
S-4 e 0830	12.0 14.0	7 6 8	1.6/2.0	12.0	STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	5	-	-
9/5 ①	15.0 16.0			15.0	M HARD	BRN	SILTSTONE	VER	AUGER REF @ 15' WEATHERED LO *JNTS @ 15.5 WATER STAINS @ 16.5, 17.1, 17.5	0	0	0	0
4.9 5.0 ②	19.0 20.0 25.0			19.0	HARD	GRAY	SANDSTONE - SOME SILTSTONE	BR	LOSING SOME DRILL H2O @ 17'± SET TEMP 6" CAS TO 15.5 SET 2"Ø PVC SCREEN 16-25 SAND 14-25 PELLETS 12-14	0	0	0	0

* When rock coring, enter rock brokenness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: CME-55 RIG, 4 1/4" ID HSA - 9" OD ±

2" SPLIT SPOONS - 140 LB HAMMER - 30" DROP

NIX CORE IN BEDROCK RUN ① = 25 min, RUN ② = 15 min

Converted to Well:

Yes

No

Well I.D. #:

MW-1

Drilling Area

Background (ppm):

0

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- Enter color of the material in the appropriate column.
- Describe material using the USCS. Limit this column for sample description only. The predominant material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:
 - Trace: 0 - 10 percent
 - Some: 11 - 30 percent
 - And/Or: 31 - 50 percent
- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.
- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.
- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:
 - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.
 - Angularity - describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.
 - Particle shape - flat, elongated, or flat and elongated.
 - Maximum particle size or dimension.
 - Water level observations.
 - Reaction with HCl - none, weak, or strong.
- Additional comments:
 - Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.
 - Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.
 - Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.
 - At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

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- Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.
- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

- Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.
- Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.
- Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.
- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.
- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.
- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.
- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:
 - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.
 - Indicate calcareous zones, description of any cavities or vugs.
 - Indicate any loss or gain of drill water.
 - Indicate drop of drill tools or change in color of drill water.
- Remarks at the bottom of Boring Log shall include:
 - Type and size of core obtained.
 - Depth casing was set.
 - Type of rig used.
- As a final check the boring log shall include the following:
 - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.
 - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

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5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock" bag for future reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely examined to determine general lithology.
- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

6.0 REFERENCES

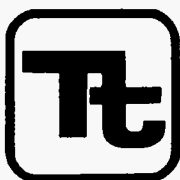
Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

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Effective Date	02/04	Revision	3
Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich <i>[Signature]</i>		

Subject
NON-RADIOLOGICAL SAMPLE HANDLING

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1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (y261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (y261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H₂SO₄
- Nitric Acid - HNO₃
- Sodium Hydroxide - NaOH

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Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - $\text{Na}_2\text{S}_2\text{O}_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological

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changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO₃, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

The FOL is responsible for ensuring that an accurate Chemical Inventory is created and maintained for all hazardous chemicals brought to the work site (see Section 5 of the TtNUS Health and Safety Guidance Manual). Furthermore, the FOL must ensure that a corresponding Material Safety Data Sheet (MSDS) is collected for every substance entered on the site Chemical Inventory, and that all persons using/handling/ disposing of these substances review the appropriate MSDS for substances they will work with. The Chemical Inventory and the MSDSs must be maintained at each work site in a location and manner where they are readily-accessible to all personnel.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H ₂ SO ₄)	1 part concentrated H ₂ SO ₄ : 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO ₃)	Undiluted concentrated HNO ₃	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

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- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.
- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).
- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory before sampling begins.

5.3 Field Filtration

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed prior to the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

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- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter and discard prior to sample collection.
- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

Only employees who have successfully completed the TtNUS "Shipping Hazardous Materials" training course are authorized to package and ship hazardous substances. These trained individuals are responsible for performing shipping duties in accordance with this training.

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)
- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.
- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic bag (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.
- Pack with enough cushioning materials such as bubble wrap (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.
- If cooling is required (see Attachments A and B), place ice around sample container shoulders, and on top of packing material (minimum of 8 pounds of ice for a medium-size cooler).
- Seal (i.e., tape or tie top in knot) large liner bag.
- The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the cooler containing the vials for VOC analysis. The COC form should then state how many coolers are included with that shipment.
- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

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Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

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ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration	Container ⁽¹⁾	Sample Size	Preservation ⁽²⁾	Holding Time ⁽²⁾
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WATER

Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days ⁽⁹⁾
	Extractables SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO ₃ to pH ≤ 2	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days

SOIL

Organics (GC&GC/MS)	VOC		EnCore Sampler	(3) 5 g Samplers	Cool to 4°C	48 hours to lab preservation
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorga nic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	35 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction

AIR

Volatile Organics	Low/Medium	Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended
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1 All glass containers should have Teflon cap liners or septa.

2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

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ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾
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INORGANIC TESTS:

Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid ⁽⁵⁾	14 days ⁽⁶⁾
Fluoride	P	None required	28 days
Hardness	P, G	HNO ₃ to pH 2; H ₂ SO ₄ to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H ₂ SO ₄ to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H ₂ SO ₄ to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

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Parameter Number/Name	Container ⁽¹⁾	Preservation ⁽²⁾⁽³⁾	Maximum Holding Time ⁽⁴⁾
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INORGANIC TESTS (Cont'd):

Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours

METALS:⁽⁷⁾

Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO ₃ to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO ₃ to pH 2	6 months

ORGANIC TESTS:⁽⁸⁾

Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ HCl to pH 2 ⁽⁹⁾	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ adjust pH to 4-5 ⁽¹⁰⁾	14 days
Phenols ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction
Benzidines ^{(11), (12)}	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction ⁽¹³⁾
Phthalate esters ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines ^{(11), (14)}	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction
PCBs ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ ; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs) ^{(11), (14)}	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾ ; store in dark	7 days until extraction; 40 days after extraction
Haloethers ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF) ⁽¹¹⁾	G, Teflon-lined cap	Cool, 4°C; 0.008% Na ₂ S ₂ O ₃ ⁽⁵⁾	7 days until extraction; 40 days after extraction

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**ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES,
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PAGE THREE**

- (1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
- (2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
- (3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
- (4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
- (5) Should only be used in the presence of residual chlorine.
- (6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
- (7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
- (8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
- (9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
- (10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
- (11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
- (12) If 1,2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0±0.2 to prevent rearrangement to benzidine.
- (13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
- (14) For the analysis of diphenylnitrosamine, add 0.008% Na₂S₂O₃ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
- (15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% Na₂S₂O₃.



STANDARD OPERATING PROCEDURES

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Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	Tom Johnston <i>T.E. Johnston</i>		

Subject DECONTAMINATION OF FIELD EQUIPMENT

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1.0 PURPOSE

Decontamination is the process of removing and/or neutralizing site contaminants that have contacted and/or accumulated on equipment. The purpose of this Standard Operating Procedure (SOP) is to protect site personnel, the general public, and the environment while preserving or maintaining sample integrity. It is further intended through this procedure to describe the steps necessary for proper decontamination of drilling equipment, earth-moving equipment, chemical sampling equipment and field operation and analytical equipment.

2.0 SCOPE AND APPLICABILITY

This procedure applies to all equipment used to provide access to/acquire environmental samples that may have become contaminated through direct contact with contaminated media including air, water, and soil. This equipment includes drilling and heavy equipment and chemical sampling and field analytical equipment. Where technologically and economically feasible, single-use sealed disposable equipment will be employed to minimize the potential for cross-contamination. This SOP also provides general reference information on the control of contaminated materials.

Decontamination methods and equipment requirements may differ from one project to another. General equipment items are specified in Section 6.0, but project-specific equipment must be obtained to address the project-specific decontamination procedures presented in Section 7.0 and applicable subsections.

3.0 GLOSSARY

Alconox/Liquinox - A brand of phosphate-free laboratory-grade detergent.

Decontamination Solution - A solution selected/identified in the Health and Safety Plan or Project-Specific Quality Assurance Plan. The solution is selected and employed as directed by the project chemist/health and safety professional.

Deionized Water (DI) - Tap water that has been treated by passing through a standard deionizing resin column. This water may also pass through additional filtering media to attain various levels of analyte-free status. The DI water should meet College of American Pathologists (CAP) and National Committee for Clinical Laboratory Standards (NCCLS) specifications for reagent-grade Type I water.

Potable Water - Tap water from any municipal water treatment system. Use of an untreated potable water supply is not an acceptable substitute for tap water.

Pressure Washing - Process employing a high-pressure pump and nozzle configuration to create a high-pressure spray of potable water. High-pressure spray is employed to remove solids from equipment.

Solvent – A liquid in which solid chemicals or other liquids are dissolved. The solvent of choice is pesticide-grade isopropanol. Use of other solvents (methanol, acetone, or hexane) may be required for particular projects or for a particular purpose (e.g., removal of concentrated waste) and must be justified in the project planning documents. For example, it may be necessary to use hexane when analyzing for trace levels of pesticides, PCBs, or fuels. In addition, because many of these solvents are not miscible in water, the equipment should be air dried prior to use. Solvents should not be used on PVC equipment or well construction materials.

Steam Pressure Washing - A cleaning method employing a high-pressure spray of heated potable water to remove various organic/inorganic chemicals from equipment.

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4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Decontamination Personnel - Individuals assigned the task of decontamination. It is the responsibility of these individuals to understand the use and application of the decontamination process and solutions as well as the monitoring of that process to ensure that it is working properly. This is accomplished through visual evaluation, monitoring instrument scanning of decontaminated items, and/or through the collection of rinsate blanks to verify contaminant removal.

Field Operations Leader (FOL) - Responsible for the implementation of project-specific planning documents. This includes on-site verification that all field activities are performed in compliance with approved SOPs or as otherwise dictated by the approved project plan(s). The FOL is also responsible for the completion and accuracy of all field documentation.

Site Safety Officer (SSO) - Exercises shared responsibility with the FOL concerning decontamination effectiveness. All equipment arriving on site (as part of the equipment inspection), leaving the site, and moving between locations is required to go through a decontamination evaluation. This is accomplished through visual examination and/or instrument screening to determine the effectiveness of the decontamination process. Improper or incomplete decontamination is sufficient to restrict equipment from entering the site, exiting the site, or moving to a new location on the site until the objectives are successfully completed.

General personnel qualifications for decontamination activities include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.
- Familiarity with appropriate decontamination procedures.

5.0 HEALTH AND SAFETY

In addition to the health and safety issues and reminders specified in subsections of this SOP, the following considerations and requirements must be observed as SOPs for field equipment decontamination activities:

- If any solvents or hazardous chemicals (e.g., isopropyl alcohol) are to be used in equipment decontamination activities, the FOL must first obtain the manufacturer's/supplier's Material Safety Data Sheet (MSDS) and assure that it is reviewed by all users (prior to its use), added to the site Hazardous Chemical Inventory, and maintained on site as part of the project Hazard Communication Program.
- Review and observe specific health and safety requirements (e.g., personal protective equipment [PPE]) specified in the project-specific health and safety plan for this activity.

6.0 EQUIPMENT LIST

- Wood for decontamination pad construction, when applicable (see Section 7.1).

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- Tools for constructing decontamination pad frame, when applicable (see Section 7.1).
- Visqueen sheeting or comparable material to cover decontamination pad frame, when applicable (see Section 7.1).
- Wash/drying racks for auger flights and drill/drive rods, when applicable (see Section 7.2).
- PPE as specified in the project health and safety plan.
- Soap and water for washing and rinsing.
- Deionized water for final rinsing.
- Solvents (e.g., pesticide-grade isopropanol) for rinsing (see applicable portions of Section 7.2).
- Tubs, buckets, etc. for containerizing rinse water (see applicable portions of Section 7.2).
- Sample bottles for collecting rinsate blanks (see Section 7.2).
- Calibrated photoionization detector (PID) or flame ionization detector (FID) to monitor decontaminated equipment for organic vapors generated through the existence of residual contamination or the presence of decontamination solvent remaining after the piece was rinsed.
- Aluminum foil or clear clean plastic bag for covering cleaned equipment (see applicable portions of Section 7.2).
- Paper towels or cloths for wiping.
- Brushes, scrapers, or other hand tools useful for removing solid materials from equipment.
- Clear plastic wrap for covering or wrapping large decontaminated equipment items (see Section 7.2.2).
- Drum-moving equipment for moving filled waste drums (optional) (see Section 7.3).
- Drum labels for waste drums (see Attachment A).

7.0 PROCEDURES

The process of decontamination is accomplished through the removal of contaminants, neutralization of contaminants, or isolation of contaminants. To accomplish this activity, preparation is required including site preparation, equipment selection, and evaluation of the decontamination requirements and processes. Site contaminant types, concentrations, and media types are primary drivers in the selection of the types of decontamination and where it will be conducted. For purposes of this SOP, discussion is limited to decontamination procedures for general environmental investigations.

Decontamination processes will be performed at the location(s) specified in project-specific planning documents. Typical decontamination locations include the following:

- Temporary decontamination pads/facilities
- Sample locations
- Centralized decontamination pad/facilities

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- Combination of some or all of the above

The following discussion includes general considerations for the decontamination process. Specific construction and implementation procedures will be as specified in the project-specific planning documents and/or may be as dictated by site-specific conditions as long as the intent of the requirements in the planning documents is met. This intent is to contain any residual fluids and solids generated through the decontamination process.

7.1 Decontamination Pad Design/Construction Considerations

7.1.1 Temporary Decontamination Pads

Temporary decontamination pads may be constructed at satellite locations within the site area in support of temporary work areas. These structures are generally constructed to support the decontamination of heavy equipment such as drill rigs and earth-moving equipment but can be employed for smaller articles.

The purpose of the decontamination pad is to contain wash waters and potentially contaminated soil generated during decontamination procedures. Therefore, construction of these pads should take into account the following considerations:

- Site location – The decontamination site selected should be far enough from the work site to maximize decontamination effectiveness while minimizing travel distance. The location of the decontamination site shall be selected to provide, in the judgment of the FOL or FOL designee, compliance with as many of the following characteristics as practicable:
 - Well removed from pedestrian/vehicle thoroughfares.
 - Avoidance of areas where control/custody cannot be maintained.
 - Avoidance of areas where potential releases of contaminated media or decontamination fluids may be compounded through access to storm water transport systems, streams, or other potentially sensitive areas.
 - Avoidance of potentially contaminated areas.
 - Avoidance of areas too close to the ongoing operation, where cross-contamination may occur.

The selected decontamination site should include the following, where possible:

- Areas where potable water and electricity are provided.

Safety Reminder

When utilizing electrical power sources, either hard-wired or portable-generated sources, ensure that:

- All power is routed through a Ground Fault Circuit Interrupter (GFCI).
- All power cords are in good condition (no physical damage), rated for the intended energy load, and designated for outdoor use.

In situations where accomplishing these elements is not possible, it will be necessary to implement a site electrical grounding program.

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- Areas where support activities such as removing decontamination waters soil and sediment are possible without entering an active exclusion zone.
- Areas that offer sufficient size to carry out the specific decontamination sequence.
- Decontamination pad (decon pad) – The decon pad shall be constructed to meet the following characteristics:
 - Size – The size of the pad should be sufficient to accept the equipment to be decontaminated as well as permitting free movement around the equipment by the personnel conducting the decontamination. The size should permit these movements utilizing pressure/steam washer wands and hoses and minimizing splash due to work in close quarters.
 - Slope – An adequate slope will be constructed to permit the collection of water and potentially contaminated soil within a trough or sump constructed at one end. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. Because the pad will be sloped, place a light coating of sand over the plastic to minimize potential slips and falls. See the text about liners below.
 - Sidewalls – The sidewalls shall be at least 6 inches in height (or as high as possible if 6 inches is not achievable) to provide adequate containment for wash waters and soil. If splash represents a potential problem, splash guards should be constructed to control overspray. Sidewalls may be constructed of wood, inflatables, sand bags, etc. to permit containment. Splash guards are typically wood frames with Visqueen coverings to control overspray.
 - Liner – Depending on the types of equipment and decontamination method to be used, the liner should be of sufficient thickness to provide a puncture-resistant barrier between the decontamination operation and the unprotected environment. Care should be taken to examine the surface area prior to placing the liner to remove sharp articles (sticks, stones, debris) that could puncture the liner. Liners are intended to form an impermeable barrier. The thickness may vary from a minimum recommended thickness of 10 mil to 30 mil. The desired thickness may be achieved through layering materials of lighter construction. It should be noted that various materials (rubber, polyethylene sheeting) become slippery when wet. To minimize this potential hazard associated with a sloped liner, a light coating of sand shall be applied to provide traction as necessary.
 - Wash/drying racks – Auger flights, drill/drive rods, and similar equipment require racks positioned off of the ground to permit these articles to be washed, drained, and dried while secured from falling during this process.

For decontamination of direct-push technology (DPT) equipment, the pad may be as simple as a mortar tub containing buckets of soapy water for washing and an empty bucket to capture rinse waters. Decontamination may be conducted at the rear of the rig to permit rapid tool exchange.

- Maintenance – Maintain the decontamination area by:
 - Periodically clearing the work area of standing water, soil, and debris, and coiling hoses to aid in eliminating slip, trip, and fall hazards. In addition, these articles will reduce potential backsplash and cross-contamination.

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- Regularly changing the decontamination fluids to ensure proper cleaning and prevent cross-contamination.
- PPE – Periodically evaluate the condition of, and maintain the decontamination equipment, including regular cleaning of face shields and safety glasses. This is critical to ensuring the safety of decontamination personnel and the integrity of the decontamination process, and it will ensure that equipment is functioning properly.

7.1.2 Decontamination Activities at Drill Rigs/DPT Units

During subsurface sampling activities including drilling and DPT activities, decontamination of drive rods, Macro Core Samplers, split spoons, etc. is typically conducted at an area adjacent to the operation. Decontamination is generally accomplished using a soap/water wash and rinse utilizing buckets and brushes. This area requires sufficient preparation to accomplish the decontamination objectives.

Buckets shall be placed within mortar tubs or similar secondary containment tubs to prevent splash and spills from reaching unprotected environmental media. Drying racks shall be employed as directed for temporary pads to permit parts to dry and be evaluated prior to use/reuse. Methodology regarding this activity is provided in Section 7.2.

7.1.3 Decontamination Activities at Remote Sample Locations

When sampling at remote locations, sampling equipment such as trowels and pumps/tubing should be evacuated of potentially contaminated media to the extent possible. This equipment should be wrapped in plastic for transport to the temporary/centralized decontamination location for final cleaning and disposition. Flushing and cleaning of single-use equipment such as disposable trowels, tubing, and surgeon's gloves may allow disposal of this equipment after visible soil and water remnants have been removed.

7.2 Equipment Decontamination Procedures

The following represents procedures to be employed for the decontamination of equipment that may have contacted and/or accumulated contamination through site investigation activities.

7.2.1 Monitoring Well Sampling Equipment

7.2.1.1 Groundwater sampling equipment – This includes pumps inserted into monitoring wells such as bladder pumps, Whale pumps, and Redi-Flo pumps and reusable bailers, etc.

1. Evacuate to the extent possible, any purge water within the pump/bailer.
2. Scrub using soap and water and/or steam clean the outside of the pump/bailer and, if applicable, the pump tubing.
3. Insert the pump and tubing/bailer into a clean container of soapy water. Pump/run a sufficient amount of soapy water through the pump/bailer to flush out any residual well water. After the pump is flushed, circulate soapy water through the pump to ensure that the internal components are thoroughly flushed.
4. Remove the pump and tubing/bailer from the container
5. Rinse external pump components using tap water.

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6. Insert the pump and tubing/bailer into a clean container of tap water. Pump/run a sufficient amount of tap water through the pump/bailer to evacuate all of the soapy water (until clear).

CAUTION

Do not rinse PE, PVC, and associated tubing with solvents –
Use the procedures defined in the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 7 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

7. If groundwater contains or is suspected to contain oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment to be cleaned with pesticide-grade isopropanol.
8. Pass deionized water through the hose to flush out the tap water and solvent residue as applicable.
9. Drain residual deionized water to the extent possible.
10. Allow components of the equipment to air dry.
11. For bladder pumps, disassemble the pump and wash the internal components with soap and water, then rinse with tap water, isopropanol, and deionized water and allow to dry. After the parts are dry, conduct a visual inspection and a monitoring instrument scan to ensure that potential contaminants and all decontamination solvent have been removed. Collect a rinsate blank in accordance with the project-specific planning documents to ensure that the decontamination process is functioning as intended. The typical frequency of collection for rinsate blanks is 1 per 20 field samples. In addition, wipe samples or field tests such as UV light may be used.
12. Wrap pump/bailer in aluminum foil or a clear clean plastic bag for storage.

SAFETY REMINDER

Remember when handling powered equipment to disconnect the power source and render the equipment to a zero energy state (both potential and kinetic) before opening valves, disconnecting lines, etc.

7.2.1.2 Electronic Water Level Indicators/Sounders/Tapes

During water level measurements, rinsing the extracted tape and probe with deionized water and wiping the surface of the extracted tape between locations is acceptable. However, periodic full decontamination should be conducted as follows:

1. Wash with soap and water
2. Rinse with tap water
3. Rinse with deionized water

NOTE

In situations where oil, grease, free product, other hard to remove materials are encountered, probes and exposed tapes should be washed in hot soapy water. If probes or tapes cannot be satisfactorily decontaminated (they are still stained, discolored, etc.), they should be removed from service.

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7.2.1.3 Miscellaneous Equipment

Miscellaneous equipment including analytical equipment (water quality testing equipment) shall be cleaned per manufacturers' instructions. This generally includes wiping the sensor housing and rinsing with tap and deionized water.

Coolers/shipping containers employed to ship samples are received from the laboratory in a variety of conditions including marginal to extremely poor. Coolers shall be evaluated prior to use for the following:

- Structural integrity – Coolers missing handles or having breaks in the outer housing should be removed and not used. Notify the laboratory that the risk of shipping samples in the cooler(s) provided is too great and request a replacement unit.
- Cleanliness – As per protocol, only volatile organic samples are accompanied by a trip blank. If a cooler's cleanliness is in question (visibly dirty/stained) or if there are noticeable odors, the cooler should be decontaminated prior to use as follows:
 1. Wash with soap and water
 2. Rinse with tap water
 3. Dry

If these measures fail to clean the cooler to an acceptable level, remove the unit from use as a shipping container and ask the cooler provider (e.g., the analytical laboratory) to provide a replacement unit.

7.2.2 **Downhole Drilling Equipment**

This includes any portion of the drill rig that is over the borehole, including auger flights, drill stems, rods, and associated tooling that would extend over the borehole. The following procedure is to be employed prior to initiating the drilling/sampling activity, then between locations:

CAUTION

Exercise care when using scrapers to remove soil and debris from downhole drilling equipment. Inadvertent slips of scrapers have resulted in cuts, scrapes, and injured knuckles, so use scrapers carefully when removing soil from these items.

1. Remove loose soil using shovels, scrapers, etc.
2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment being decontaminated.

CAUTION

In Step 3, do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

3. Rinse the equipment with tap water, where applicable (steam cleaning and pressure washing incorporate rinsing as part of the process).

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4. If the equipment has directly or indirectly contacted contaminated sample media and is known or suspected of being contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse equipment with pesticide-grade isopropanol
5. To the extent possible, allow components to air dry.
6. If the decontaminated equipment is to be used immediately after decontamination, screen it with a calibrated photoionization detector (PID)/flame ionization detector (FID) to ensure that all contaminants and possible decontamination solvents (if they were used) have been adequately removed.
7. Wrap or cover equipment in clear plastic until it is time to be used.

SAFETY REMINDER

Even when equipment is disconnected from power sources, dangers such as the following may persist:

Falls - An auger flight standing on its end may fall and injure someone. Secure all loose articles to prevent heavy articles from falling onto people or equipment.

Burns - Steam cleaner water is heated to more than 212 °F and exhibits thermal energy that can cause burns. Prevent contact of skin with hot water or surfaces.

High water pressure - Pressure washer discharge can have 2,000 to 4,000 psi of water pressure. Water under this amount of pressure can rupture skin and other human tissues. Water at 4,000 psi exiting a 0° tip can be dangerous because of its relatively high cutting power. The exit velocity and cutting power of the water are reduced when exiting a 40° fan tip, but damage to soft tissues is still possible.

In general, follow the rules below to avoid injury, equipment damage, or incomplete decontamination:

1. Read the operating manual and follow the manufacturers' recommended safety practices before operating pressure washers and steam cleaners.
2. Never point the pressure washer or steam cleaner at another person or use to clean your boots or other parts of your body. Water lacerations and burns may appear to be minor at first but can be life threatening. Do not attempt to hold small parts in your hand while washing them with high-temperature or high-pressure water.
3. Always wear PPE as specified in the HASP such as:
 - Hard hat, safety glasses, splash shield, impermeable apron or splash suit, and hearing protection. Remember that excessive noise is a hazard when operating gas-powered engines and electrically driven pressure washers. PPE will be identified in your project specific planning documents.
4. Inspect each device before use. An inspection checklist will be provided in the project-specific planning documents. If it is a rented device, safety measures are typically provided by the vendor. In all cases, if you are not familiar with the operation of a pressure washer/steam cleaner, do not operate it until you obtain and thoroughly review operating instructions and recommended safety practices.
5. Do not modify equipment unless the manufacturer has approved the modifications.

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7.2.3 Soil/Sediment Sampling Equipment

This section applies to soil sampling equipment including but not limited to hand augers, stainless steel trowels/spoons, bowls, dredges, scoops, split spoons, Macro Core samplers, etc.

1. Remove all loose soil from the equipment through manual means.
2. Through a combination of scrubbing using soap and water and/or steam cleaning or pressure washing, remove visible dirt/soil from the equipment.
3. Rinse the equipment with tap water.

CAUTION

Do not rinse PE, PVC, and associated tubing with solvents. The appropriate procedures should be defined within the project-specific planning documents. If they are not defined, contact the FOL for guidance. The solvent rinse described in Step 4 may be omitted if groundwater does not contain oil, grease, PAHs, PCBs, or other hard to remove organic materials.

4. If the equipment is contaminated or suspected to be contaminated with oil, grease, PAHs, PCBs, or other hard to remove organic materials, rinse the equipment with pesticide-grade isopropanol.
5. Rinse the equipment with deionized water.
6. To the extent possible, allow components to air dry.
7. If the equipment is to be used immediately after decontamination, screen it with a calibrated PID/FID to ensure that all solvents (if they were used) and trace contaminants have been adequately removed.
8. After the equipment has dried, wrap it in aluminum foil for storage until use.

Dredges employed in sediment sampling are typically decontaminated as follows:

- Remove the sediment sample from the sampling device
- If sufficient associated surface water is available at the sampling site, place the dredge in the water and flush to remove visible sediment.
- Extract the dredge and wash it in soap and water per the project-specific planning documents.

CAUTION

When handling dredges, the primary safety concern is trapping fingers or extremities in the larger dredge samplers within the jaws or pinch points of the mechanical jaws. Keep hands, fingers, and extremities away from these pinch and compression points. Either handle the device by the rope or preferably lock the jaws in place to control the potential for closing during maintenance and/or cleaning.

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7.3 **Contact Waste/Materials**

During the course of field investigations, disposable/single-use equipment becomes contaminated. These items include tubing, trowels, PPE (gloves, overboots, splash suits, etc.), and broken sample containers.

With the exception of the broken glass, single-use articles should be cleaned (washed and rinsed) of visible materials and disposed as normal refuse. The exception to this rule is that extremely soiled materials that cannot be cleaned shall be containerized for disposal in accordance with applicable federal, state, and local regulations.

7.3.1 **Investigation-Derived Wastes - Decontamination Wash Waters and Sediments**

NOTE

Requirements for waste storage may differ from one facility to the next. Facility-specific directions for waste storage areas will be provided in project-specific documents, or separate direction will be provided by the Project Manager.

1. Assume that all investigation-derived waste (IDW) generated from decontamination activities contains the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. Waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.
2. Where possible, use filtering systems to extend the use of water within a closed system wash unit to recycle water and to reduce possible waste amounts.

NOTE

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility.

3. Label waste storage containers appropriately labeled (see Attachment A).
4. Ensure that the IDW storage area is configured to meet the following specifications to permit access to the containers and to conduct spill/leak monitoring, sampling, and extraction when the disposal route is determined:
 - Enclose areas accessible by the general public using construction fencing and signs.
 - Stored materials in 55-gallon drums on pallets with four (or fewer) drums per pallet.
 - Maintain the retaining bolt and label on the outside of storage containers where readily visible.
 - Provide at least 4 feet of room between each row of pallets to allow access to containers for sampling, drum removal, and spill response.
 - As directed in project-specific planning documents, maintain an IDW Inventory List and provide the list to the site Point of Contact at the termination of each shift.
 - Maintain spill response equipment at the IDW storage area in case it is required for immediate access.

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- Where possible, use equipment for moving containers. Where not possible, obtain help to manipulate containers.

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CAUTION

Each container of water can weigh up to 490 pounds. Each 55-gallon drum of wet soil can weigh more than 750 pounds. Fill drums and temporary containers to 80 percent capacity to minimize spill and handling difficulties. Use drum carts to move filled drums.

See safe lifting techniques provided in Section 4.4 of the Tetra Tech NUS, Inc. Health and Safety Guidance Manual.

When placing drums, keep your fingers out of pinch and smash points such as between the drums. In some cases such as well development and/or purge water, you can place the drums to be filled on the pallet and transport materials in smaller easier to handle containers.

7.4 **Decontamination Evaluation**

Upon decontamination of equipment, determine the effectiveness of the decontamination process in the following manner:

- Visual evaluation – A visual evaluation will be conducted to ensure the removal of particulate matter. This shall be done to ensure that the washing/rinsing process is working as intended.
- Instrument Screening – A properly calibrated PID/FID should be used to evaluate the presence of site contaminants and solvents used in the cleaning process. The air intake of the instrument shall be passed over the article to be evaluated. Avoid placing the instrument probe into residual waters. A PID/FID reading greater than the daily established background level requires a repeat of the decontamination process, followed by rescreening with the PID/FID. This sequence must be repeated until no instrument readings greater than the daily established background level are observed. It should be noted that the instrument scan is only viable if the contaminants are detectable within the instrument's capabilities.

NOTE

When required by project-specific planning documents, collection of rinsate blanks (see next step) shall be completed without exception unless approval to not collect these samples is obtained from the Project Manager.

- Collection of Rinsate Blanks – It is recommended that rinsate samples be collected to:
 - Evaluate the decontamination procedure representing different equipment applications (pumps versus drilling equipment) and different decontamination applications.
 - Single-use disposable equipment – The number of samples should represent different types of equipment as well as different lot numbers of single-use articles.
 - The collection and the frequency of collection of rinsate samples are as follows unless specified differently in the project-specific planning documents:
 - Per decontamination method
 - Per disposable article/batch number of disposable articles

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NOTE

It is recommended that an initial rinsate sample be collected early in the project to ensure that the decontamination process is functioning properly and to avoid using a contaminated batch of single-use articles. It is recommended that a follow-up sample be collected later during the execution of the project to ensure that those conditions do not change.

Rinsate samples collection may be driven by types of and/or levels of contaminant. Difficult to remove contaminants, oils/greases, some PAHs/PCBs, etc. may also support the collection of additional rinsates due to the obvious challenges to the decontamination process. This is a field consideration to be determined by the FOL.



TETRA TECH

STANDARD OPERATING PROCEDURES

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Effective Date	01/28/2009	Revision	6
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Applicability	Tetra Tech NUS, Inc.
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Prepared	Earth Sciences Department
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Approved	Tom Johnston 
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Subject DECONTAMINATION OF FIELD EQUIPMENT

Attachment A IDW Label

INVESTIGATION DERIVED WASTE

GENERATOR INFORMATION:

SITE _____ JOB NO. _____

LOCATION _____

DATE _____

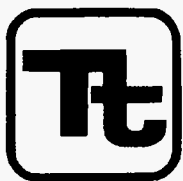
DRUM# _____

CONTENTS _____

VOLUME _____


CONTACT _____

EMERGENCY PHONE NUMBER _____



TETRA TECH NUS, INC.

STANDARD OPERATING PROCEDURES

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Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	D. Senovich 		

Subject
GROUNDWATER MONITORING WELL INSTALLATION

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1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper monitoring well design, installation, and development.

2.0 SCOPE

This procedure is applicable to the construction of monitoring wells. The methods described herein may be modified by project-specific requirements for monitoring well construction. In addition, many regulatory agencies have specific regulations pertaining to monitoring well construction and permitting. These requirements must be determined during the project planning phases of the investigation, and any required permits must be obtained before field work begins. Innovative monitoring well installation techniques, which typically are not used, will be discussed only generally in this procedure.

3.0 GLOSSARY

Monitoring Well - A well which is screened, cased, and sealed which is capable of providing a groundwater level and groundwater sample representative of the zone being monitored. Some monitoring wells may be constructed as open boreholes.

Piezometer - A pipe or tube inserted into the water bearing zone, typically open to water flow at the bottom and to the atmosphere at the top, and used to measure water level elevations. Piezometers may range in size from 1/2-inch-diameter plastic tubes to well points or monitoring wells.

Potentiometric Surface - The surface representative of the level to which water will rise in a well cased to the screened aquifer.

Well Point (Drive Point) - A screened or perforated tube (Typically 1-1/4 or 2 inches in diameter) with a solid, conical, hardened point at one end, which is attached to a riser pipe and driven into the ground with a sledge hammer, drop weight, or mechanical vibrator. Well points may be used for groundwater injection and recovery, as piezometers (i.e., to measure water levels) or to provide groundwater samples for water quality data.

4.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The driller may also be responsible for obtaining, in advance, any required permits for monitoring well installation and construction.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller, and insures that well construction is adequate to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

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5.0 PROCEDURES

5.1 Equipment/Items Needed

Below is a list of items that may be needed when installing a monitoring well or piezometer:

- Health and safety equipment (hard hats, safety glasses, etc.) as required by the Site Safety Officer.
- Well drilling and installation equipment with associated materials (typically supplied by the driller).
- Hydrogeologic equipment (weighted engineer's tape, water level indicator, retractable engineers rule, electronic calculator, clipboard, mirror and flashlight - for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, and a field notebook).
- Drive point installation tools (sledge hammer, drop hammer, or mechanical vibrator; tripod, pipe wrenches, drive points, riser pipe, and end caps).

5.2 Well Design

The objectives and intended use for each monitoring well must be clearly defined before the monitoring system is designed. Within the monitoring system, different monitoring wells may serve different purposes and, therefore, require different types of construction. During all phases of the well design, attention must be given to clearly documenting the basis for design decisions, the details of well construction, and the materials used. The objectives for installing the monitoring wells may include:

- Determining groundwater flow directions and velocities.
- Sampling or monitoring for trace contaminants.
- Determining aquifer characteristics (e.g., hydraulic conductivity).

Siting of monitoring wells shall be performed after a preliminary estimation of the groundwater flow direction. In most cases, groundwater flow directions and potential well locations can be determined by an experienced hydrogeologist through the review of geologic data and the site terrain. In addition, data from production wells or other monitoring wells in the area may be used to determine the groundwater flow direction. If these methods cannot be used, piezometers, which are relatively inexpensive to install, may have to be installed in a preliminary investigative phase to determine groundwater flow direction.

5.2.1 Well Depth, Diameter, and Monitored Interval

The well depth, diameter, and monitored interval must be tailored to the specific monitoring needs of each investigation. Specification of these items generally depends on the purpose of the monitoring system and the characteristics of the hydrogeologic system being monitored. Wells of different depth, diameter, and monitored interval can be employed in the same groundwater monitoring system. For instance, varying the monitored interval in several wells, at the same location (cluster wells) can help to determine the vertical gradient and the depths at which contaminants are present. Conversely, a fully penetrating well is usually not used to quantify or vertically locate a contaminant plume, since groundwater samples collected in wells that are screened over the full thickness of the water-bearing zone will be representative of average conditions across the entire monitored interval. However, fully penetrating wells can be used to establish the existence of contamination in the water-bearing zone. The well diameter desired depends upon the hydraulic characteristics of the water-bearing zone, sampling requirements, drilling method and cost.

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The decision concerning the monitored interval and well depth is based on the following (and possibly other) information:

- The vertical location of the contaminant source in relation to the water-bearing zone.
- The depth, thickness and uniformity of the water-bearing zone.
- The anticipated depth, thickness, and characteristics (e.g., density relative to water) of the contaminant plume.
- Fluctuation in groundwater levels (due to pumping, tidal influences, or natural recharge/discharge events).
- The presence and location of contaminants encountered during drilling.
- Whether the purpose of the installation is for determining existence or non-existence of contamination or if a particular stratigraphic zone is being investigated.
- The analysis of borehole geophysical logs.

In most situations where groundwater flow lines are horizontal, depending on the purpose of the well and the site conditions, monitored intervals are 20 feet or less. Shorter screen lengths (5 feet or less) are usually required where flow lines are not horizontal, (i.e., if the wells are to be used for accurate measurement of the potentiometric head at a specific point).

Many factors influence the diameter of a monitoring well. The diameter of the monitoring well depends on the application. In determining well diameter, the following needs must be considered:

- Adequate water volume for sampling.
- Drilling methodology.
- Type of sampling device to be used.
- Costs.

Standard monitoring well diameters are 2, 4, 6, or 8 inches. Drive points are typically 1-1/4 or 2 inches in diameter. For monitoring programs which require screened monitoring wells, either a 2-inch or 4-inch-diameter well is preferred. Typically, well diameters greater than 4 inches are used in monitoring programs in which open-hole bedrock monitoring wells are used. With smaller diameter wells, the volume of stagnant water in the well is minimized, and well construction costs are reduced; however, the sampling devices that can be used are limited.

In specifying well diameter, sampling requirements must be considered (up to a total of 4 gallons of water may be required for a single sample to account for full organic and inorganic analyses, and split samples), particularly if the monitored formation is known to be a low-yielding formation. The unit volume of water contained within a monitoring well is dependent on the well diameter as follows:

Casing Inside Diameter (Inch)	Standing Water Length to Obtain 1 Gallon Water (Feet)
2	6.13
4	1.53
6	0.68

If a well recharges quickly after purging, then well diameter may not be an important factor regarding sample volume requirements.

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Pumping tests for determining aquifer characteristics may require larger diameter wells (for installation of high capacity pumps); however, in small-diameter wells in-situ permeability tests can be performed during drilling or after well installation is completed.

5.2.2 Riser Pipe and Screen Materials

Well materials are specified by diameter, type of material, and thickness of pipe. Well screens require an additional specification of slot size. Thickness of pipe is referred to as "Schedule" for polyvinyl chloride (PVC) casing and is usually Schedule 40 (thinner wall) or 80 (thicker wall). Steel pipe thickness is often referred to as "Strength". Standard Strength is usually adequate for monitoring well purposes. With larger diameter pipe, the wall thickness must be greater to maintain adequate strength. The required thickness is also dependent on the method of installation; risers for drive points require greater strength than wells installed inside drilled borings.

The selection of well screen and riser materials depends on the method of drilling, the type of subsurface materials the well penetrates, the type of contamination expected, and natural water quality and depth. Cost and the level of accuracy required are also important. The materials generally available are Teflon, stainless steel, PVC galvanized steel, and carbon steel. Each has advantages and limitations (see Attachment A of this guideline for an extensive presentation on this topic). The two most commonly used materials are PVC and stainless steel. Properties of these two materials are compared in Attachment B. Stainless steel is a good choice where trace metals or organic sampling is required; however, costs are high. Teflon materials are extremely expensive, but are relatively inert and provide the least opportunity for water contamination due to well materials. PVC has many advantages, including low cost, excellent availability, light weight, ease of manipulation, and widespread acceptance. The crushing strength of PVC may limit the depth of installation, but the use of Schedule 80 materials may overcome some of the problems associated with depth. However, the smaller inside diameter of Schedule 80 pipe may be an important factor when considering the size of bailers or pumps required for sampling or testing. Due to this problem, the minimum well pipe size recommended for Schedule 80 wells is 4-inch I.D.

Screens and risers may have to be decontaminated before use because oil-based preservatives and oil used during thread cutting and screen manufacturing may contaminate samples. Metal pipe may corrode and release metal ions or chemically react with organic constituents, but this is considered a minor issue. Galvanized steel is not recommended where samples may be collected for metals analyses, as zinc and cadmium levels in groundwater samples may become elevated from leaching of the zinc coating.

Threaded, flush-joint casing is most often preferred for monitoring well applications. PVC, Teflon, and steel can all be obtained with threaded joints. Welded-joint steel casing is also acceptable. Glued PVC may release organic contaminants into the well, and therefore, should not be used if the well is to be sampled for organic constituents.

When the water-bearing zone is in consolidated bedrock, such as limestone or fractured granite, a well screen is often not necessary (the well is simply an open hole in bedrock). Unconsolidated materials, such as sands, clay, and silts require a screen. A screen slot size of 0.010 or 0.020 inch is generally used when a screen is necessary, and the annular borehole space around the screened interval is artificially packed with an appropriately sized sand, selected based on formation grain size. The slot size controls the quantity of water entering the well and prevents entry of natural materials or sand pack. The screen shall pass no more than 10 percent of the pack material, or in-situ aquifer material. The site geologist shall specify the combination of screen slot size and sand pack which will be compatible with the water-bearing zone, to maximize groundwater inflow and minimize head losses and movement of fines into the wells. For example, as a standard procedure, a Morie No. 1 or No. 10 to No. 20 U.S. Standard Sieve size filter pack is typically appropriate for a 0.020-inch slot screen; however, a No. 20 to No. 40 U.S. Standard Sieve size filter pack is typically appropriate for a 0.010-inch slot screen.

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5.2.3 Annular Materials

Materials placed in the annular space between the borehole and riser pipe and screen include a sand pack when necessary, a bentonite seal, and cement-bentonite grout. The sand pack is usually a medium-to coarse-grained poorly graded, silica sand and should relate to the grain size of the aquifer sediments. The quantity of sand placed in the annular space is dependent upon the length of the screened interval, but should always extend at least 1 foot above the top of the screen. At least 1 to 3 feet of bentonite pellets or equivalent shall be placed above the sand pack. Cement-bentonite grout (or equivalent) is then placed to extent from the top of the bentonite pellets to the ground surface.

On occasion, and with the concurrence of the involved regulatory agencies, monitoring wells may be packed naturally (i.e., no artificial sand pack installed). In this case, the natural formation material is allowed to collapse around the well screen after the well is installed. This method has been used where the formation material itself is a relatively uniform grain size, or when artificial sand packing is not possible due to borehole collapse.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets, extending to the surface. The grout effectively seals the remaining borehole annulus and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom upward, to prevent bridging, and to provide a better seal. In shallow boreholes that don't collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

Grout is a general term which has several different connotations. For all practical purposes within the monitoring well installation industry, grout refers to the solidified material which is installed and occupies the annular space above the bentonite pellet seal. Grout, most of the time, is made up of one or two assemblages of material, (e.g., cement and/or bentonite). A cement-bentonite grout, which is the most common type of grout used in monitoring well completions, normally is a mixture of cement, bentonite, and water at a ratio of one 90-pound bag of Portland Type I cement, plus 3 to 5 pounds of granular or flake-type bentonite, and 6-7 gallons of water. A neat cement consists of one ninety-pound bag of Portland Type I cement and 6-7 gallons of water. A bentonite slurry (bentonite and water mixed to a thick but pumpable mixture) is sometimes used instead of grout for deep well installations where placement of bentonite pellets is difficult. Bentonite chips are also occasionally used for annular backfill in place of grout.

In certain cases, the borehole may be drilled to a depth greater than the anticipated well installation depth. For these cases, the well shall be backfilled to the desired depth with bentonite pellets/chips or sand. A short (1- to 2-foot) section of capped riser pipe sump is sometimes installed immediately below the screen, as a silt reservoir, when significant post-development silting is anticipated. This will ensure that the entire screen surface remains unobstructed.

5.2.4 Protective Casing

When the well is completed and grouted to the surface, a protective steel casing is typically placed over the top of the well. This casing generally has a hinged cap and can be locked to prevent vandalism. The protective casing has a larger diameter than the well and is set into the wet cement grout over the well upon completion. In addition, one hole is drilled just above the cement collar through the protective casing which acts as a weep hole for the flow of water which may enter the annulus during well development, purging, or sampling.

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A protective casing which is level with the ground surface (flush-mounted) is used in roadway or parking lot applications where the top of a monitoring well must be below the pavement. The top of the riser pipe is placed 4 to 5 inches below the pavement, and a locking protective casing is cemented in place to 3 inches below the pavement. A large diameter, manhole-type protective collar is set into the wet cement around the well with the top set level with or slightly above the pavement. An appropriately-sized id is placed over the protective sleeve. The cement should be slightly mounded to direct pooled water away from the well head.

5.3 Monitoring Well Installation

Pertinent data regarding monitoring well installation shall be recorded on log sheets as depicted and discussed in SOP SA-6.3. Attachments to this referenced SOP illustrate terms and physical construction of various types of monitoring wells.

5.3.1 Monitoring Wells in Unconsolidated Sediments

After the borehole is drilled to the desired depth, well installation can begin. The procedure for well installation will partially be dictated by the stability of the formation in which the well is being placed. If the borehole collapses immediately after the drilling tools are withdrawn, then a temporary casing must be installed and well installation will proceed through the center of the temporary casing, and continue as the temporary casing is withdrawn from the borehole. In the case of hollow-stem auger drilling, the augers will act to stabilize the borehole during well installation.

Before the screen and riser pipe are lowered into the borehole, all pipe and screen sections should be measured with an engineer's rule to ensure proper placement. When measuring sections, the threads on one end of the pipe or screen must be excluded while measuring, since the pipe and screen sections are screwed flush together.

After the screen and riser pipe are lowered through the temporary casing, the sand pack can be installed. A weighted tape measure must be used during the installation procedure to carefully monitor installation progress. The sand is slowly poured into the annulus between the riser pipe and temporary casing, as the casing is withdrawn. Sand should always be kept within the temporary casing during withdrawal in order to ensure an adequate sand pack. However, if too much sand is within the temporary casing (greater than 1 foot above the bottom of the casing) bridging between the temporary casing and riser pipe may occur. Centralizers may be used at the geologist's discretion, one above and one below the screen, to assure enough annular space for sand pack placement.

After the sand pack is installed to the desired depth (at least 1 foot above the top of the screen), then the bentonite pellet seal (or equivalent), can be installed in the same manner as the sand pack. At least 1 to 3 feet of bentonite pellets should be installed above the sand pack. Pellets should be added slowly and their fall monitored closely to ensure that bridging does not occur.

The cement-bentonite grout is then mixed and tremied into the annulus as the temporary casing or augers are withdrawn. Finally, the protective casing can be installed as detailed in Section 5.2.4.

5.3.2 Confining Layer Monitoring Wells

When drilling and installing a well in a confined aquifer, proper well installation techniques must be applied to avoid cross contamination between aquifers. Under most conditions, this can be accomplished by installing double-cased wells. This is accomplished by drilling a large-diameter boring through the upper aquifer, 1 to 5 feet into the underlying confining layer, and setting and pressure grouting or tremie grouting a large-diameter casing into the confining layer. The grout material must fill the space between the native material and the outer casing. A smaller diameter boring is then continued through the confining layer for

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installation of the monitoring well as detailed for overburden monitoring wells. Sufficient time (determined by the field geologist), must be allowed for setting of the grout prior to drilling through the confined layer.

5.3.3 Bedrock Monitoring Wells

When installing bedrock monitoring wells, a large diameter boring is drilled through the overburden and approximately 5 –10 feet into bedrock. A casing (typically steel) is installed and either pressure grouted or tremie grouted in place. After the grout has cured, a smaller diameter boring is continued into bedrock to the desired depth. If the boring does not collapse, the well can be left open, and a screen is not necessary. If the boring collapses, then a screen is required and can be installed as detailed for overburden monitoring wells. If a screen is to be used, then the casing which is installed through the overburden and into the bedrock does not require grouting and can be removed when the final well installation is completed.

5.3.4 Drive Points

Drive points can be installed with either a sledge hammer, drop hammer, or a mechanical vibrator. The screen section is threaded and tightened onto the riser pipe with pipe wrenches. The drive point is simply pounded into the subsurface to the desired depth. If a heavy drop hammer is used, then a tripod and pulley setup is required to lift the hammer. Drive points typically cannot be manually driven to depths exceeding 10 feet.

Direct push sampling/monitoring point installation methods, using a direct push rig or drilling rig, are described in SOP SA-2.5.

5.3.5 Innovative Monitoring Well Installation Techniques

Certain innovative sampling devices have proven advantageous. These devices are essentially screened samplers installed in a borehole with only small-diameter tubes extending to the surface. This reduces drilling costs, decreases the volume of stagnant water, and provides a sampling system that minimizes cross-contamination from sampling equipment. Four manufacturers of these samplers include Timco Manufacturing Company, Inc., of Prairie du Sac, Wisconsin, BARCAD Systems, Inc., of Concord, Massachusetts, Westbay Instruments Ltd. of Vancouver, British Columbia, Canada and the University of Waterloo at Waterloo, Ontario, Canada.. Each manufacturer offers various construction materials.

5.4 Well Development Methods

The purpose of well development is to stabilize and increase the permeability of the gravel pack around the well screen, and to restore the permeability of the formation which may have been reduced by drilling operations. Wells are typically developed until all fine material and drilling water is removed from the well. Sequential measurements of pH, conductivity, turbidity, and temperature taken during development may yield information (stabilized values) regarding whether sufficient development has been performed. The selection of the well development method shall be made by the field geologist and is based on the drilling methods, well construction and installation details, and the characteristics of the formation that the well is screened in. The primary methods of well development are summarized below. A more detailed discussion may be found in Driscoll (1986).

5.4.1 Overpumping and Backwashing

Wells may be developed by alternatively drawing the water level down at a high rate (by pumping or bailing) and then reversing the flow direction (backwashing) so that water is passing from the well into the formation. This back and forth movement of water through the well screen and gravel pack serves to

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remove fines from the formation immediately adjacent to the well, while preventing bridging (wedging) of sand grains. Backwashing can be accomplished by several methods, including pouring water into the well and then bailing, starting and stopping a pump intermittently to change water levels, or forcing water into the well under pressure through a water-tight fitting ("rawhiding"). Care should be taken when backwashing not to apply too much pressure, which could damage or destroy the well screen.

5.4.2 Surging with a Surge Plunger

A surge plunger (also called a surge block) is approximately the same diameter as the well casing and is aggressively moved up and down within the well to agitate the water, causing it to move in and out of the screens. This movement of water pulls fine materials into the well, where they may be removed by any of several methods, and prevents bridging of sand particles in the gravel pack. There are two basic types of surge plungers; solid and valved surge plungers. In formations with low yields, a valved surge plunger may be preferred, as solid plungers tend to force water out of the well at a greater rate than it will flow back in. Valved plungers are designed to produce a greater inflow than outflow of water during surging.

5.4.3 Compressed Air

Compressed air can be used to develop a well by either of two methods: backwashing or surging. Backwashing is done by forcing water out through the screens, using increasing air pressure inside a sealed well, then releasing the pressurized air to allow the water to flow back into the well. Care should be taken when using this method so that the water level does not drop below the top of the screen, thus introducing air into the formation and reducing well yield. Surging, or the "open well" method, consists of alternately releasing large volumes of air suddenly into an open well below the water level to produce a strong surge by virtue of the resistance of water head, friction, and inertia. Pumping of the well is subsequently done using the air lift method.

5.4.4 High Velocity Jetting

In the high velocity jetting method, water is forced at high velocities from a plunger-type device and through the well screen to loosen fine particles from the sand pack and surrounding formation. The jetting tool is slowly rotated and raised and lowered along the length of the well screen to develop the entire screened area. Jetting using a hose lowered into the well may also be effective. The fines washed into the screen during this process can then be bailed or pumped from the well.

6.0 RECORDS

A critical part of monitoring well installation is recording of all significant details and events in the site logbook or field notebook. The geologist must record the exact depths of significant hydrogeological features, screen placement, gravel pack placement, and bentonite placement.

A Monitoring Well Sheet (see Attachments to SOP SA-6.3) shall be completed, ensuring the uniform recording of data for each installation and rapid identification of missing information. Well depth, length, materials of construction, length and openings of screen, length and type of riser, and depth and type of all backfill materials shall be recorded. Additional information shall include location, installation date, problems encountered, water levels before and after well installation, cross-reference to the geologic boring log, and methods used during the installation and development process. Documentation is very important to prevent problems involving questionable sample validity. Somewhat different information will need to be recorded, depending on whether the well is completed in overburden (single- or double-cased), as a cased well in bedrock, or as an open hole in bedrock.

The quantities of sand, bentonite, and grout placed in the well are also important. The geologist shall calculate the annular space volume and have an idea of the quantity of material needed to fill the annular

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space. Volumes of backfill significantly higher than the calculated volume may indicate a problem such as a large cavity, while a smaller backfill volume may indicate a cave-in or bridging of the backfill materials. Any problems with rig operation or down-time shall be recorded and may affect the driller's final fee.

7.0 REFERENCES

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ATTACHMENT A

RELATIVE COMPATIBILITY OF RIGID WELL CASING MATERIAL (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material						
	PVC 1	Galvanized Steel	Carbon Steel	Lo-carbon Steel	Stainless Steel 304	Stainless Steel 316	Teflon*
Buffered Weak Acid	100	56	51	59	97	100	100
Weak Acid	98	59	43	47	96	100	100
Mineral Acid/ High Solids Content	100	48	57	60	80	82	100
Aqueous/Organic Mixtures	64	69	73	73	98	100	100
Percent Overall Rating	91	58	56	59	93	96	100

Preliminary Ranking of Rigid Materials:

1	Teflon®	5	Lo-Carbon Steel
2	Stainless Steel 316	6	Galvanized Steel
3.	Stainless Steel 304	7	Carbon Steel
4	PVC 1		

* Trademark of DuPont

RELATIVE COMPATIBILITY OF SEMI-RIGID OR ELASTOMERIC MATERIALS (PERCENT)

Potentially-Deteriorating Substance	Type of Casing Material								
	PVC Flexible	PP	PE Conv.	PE Linear	PMM	Viton®*	Silicone	Neoprene	Teflon®*
Buffered Weak Acid	97	97	100	97	90	92	87	85	100
Weak Acid	92	90	94	96	78	78	75	75	100
Mineral Acid/ High Solids Content	100	100	100	100	95	100	78	82	100
Aqueous/Organic Mixtures	62	71	40	60	49	78	49	44	100
Percent Overall Rating	88	90	84	88	78	87	72	72	100

Preliminary Ranking of Semi-Rigid or Elastomeric Materials:

1	Teflon®	5	PE Conventional
2	Polypropylene (PP)	6	Plexiglas/Lucite (PMM)
3.	PVC Flexible/PE Linear	7	Silicone/Neoprene
4	Viton®		

* Trademark of DuPont

Source: Barcelona et al., 1983

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ATTACHMENT B

COMPARISON OF STAINLESS STEEL AND PVC FOR MONITORING WELL CONSTRUCTION

Characteristic	Stainless Steel	PVC
Strength	Use in deep wells to prevent compression and closing of screen/riser.	Use when shear and compressive strength are not critical.
Weight	Relatively heavier.	Light-weight; floats in water.
Cost	Relatively expensive.	Relatively inexpensive.
Corrosivity	Deteriorates more rapidly in corrosive water.	Non-corrosive -- may deteriorate in presence of ketones, aromatics, alkyl sulfides, or some chlorinated hydrocarbons.
Ease of Use	Difficult to adjust size or length in the field.	Easy to handle and work with in the field.
Preparation for Use	Should be steam cleaned if organics will be subsequently sampled.	Never use glue fittings -- pipes should be threaded or pressure fitted. Should be steam cleaned when used for monitoring wells.
Interaction with Contaminants*	May sorb organic or inorganic substances when oxidized.	May sorb or release organic substances.

* See also Attachment A.



TETRA TECH

STANDARD OPERATING PROCEDURES

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Applicability	Tetra Tech NUS, Inc.		
Prepared	Earth Sciences Department		
Approved	Tom Johnston <i>T.E. Johnston</i>		

Subject

GROUNDWATER SAMPLE ACQUISITION AND
ONSITE WATER QUALITY TESTING

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1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the process to be used for purging groundwater monitoring wells prior to sampling, for collecting groundwater samples, and for measuring groundwater quality parameters.

2.0 SCOPE

This document provides information on proper sampling equipment, onsite water quality testing, safety measures to ensure the safety of the field technician(s), and techniques for groundwater sampling. All personnel are encouraged to review the information contained herein to facilitate planning of the field sampling effort. The techniques described shall be followed whenever applicable, noting that site-specific conditions or project-specific plans may require modifications to methodology.

3.0 GLOSSARY

Conductivity – Conductivity is a numerical expression of the ability of an aqueous solution to carry an electric current. This ability depends on the presence of ions and their total concentration, mobility, valence, and relative concentrations and on temperature. Conductivity is highly dependent on temperature and should be reported at a particular temperature, i.e., 20.2 microSiemens per centimeter (mS/cm) at 14°C.

Dissolved Oxygen (DO) – DO levels in natural and wastewater depend on the physical, chemical, and biochemical activities in the water sample.

Groundwater Sample – A quantity of water removed from the ground, usually via a monitoring well that may or may not be lined with a well casing.

Oxidation-Reduction Potential (ORP) - A measure of the activity ratio of oxidizing and reducing species as determined by the electromotive force developed by a noble metal electrode immersed in water, as referenced against a reference electrode. A reference electrode commonly used in the field is the silver/silver chloride electrode, which has a voltage offset of about 210 mV from the standard hydrogen electrode (SHE). To convert field ORP measurements to equivalent SHE values, approximately 210 mV must be added to the ORP values obtained using the silver/silver chloride electrode. The actual offset depends on the concentration of the potassium chloride (KCl) in the field reference electrode and the temperature. Offsets typically range from 199 (saturated KCl) to 205 (3.5 Molar KCl) to 222 mV (1 Molar KCl) at 25°C and are greater at lower temperatures.

pH - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration.

pH Paper - Indicator paper that turns different colors depending on the pH of the solution to which it is exposed. Comparison with color standards supplied by the manufacturer will then give an indication of the solution's pH.

Representativeness – A qualitative description of the degree to which an individual sample accurately reflects population characteristics or parameter variations at a sampling point. It is therefore an important characteristic not only of assessment and quantification of environmental threats posed by the site, but also for providing information for engineering design and construction. Proper sample location selection and proper sample collection methods are important to ensure that a truly representative sample has been collected.

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Salinity – The measurement of dissolved salts in a given mass of solution. Note: most field meters determined salinity automatically from conductivity and temperature. The value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent). The parts per thousand symbol ($^{0}/_{00}$) is not the same as the percent symbol (%).

Turbidity – Turbidity in water is caused by suspended matter such as clay, silt, and fine organic and inorganic matter. Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample.

4.0 RESPONSIBILITIES AND PERSONNEL QUALIFICATIONS

Project Manager - The Project Manager is responsible for determining the sampling objectives, initial sampling locations, and field procedures used in the collection of groundwater samples. Additionally, in consultation with other project personnel (geologist, hydrogeologist, etc.), the Project Manager identifies sampling locations.

Site Safety Officer (SSO) - The SSO (or a qualified designee) is responsible for providing the technical support necessary to implement the project Health and Safety Plan (HASP). This includes but is not be limited to performing air quality monitoring during sampling, boring and excavation activities, and ensuring that workers and offsite (downwind) individuals are not exposed to hazardous levels of airborne contaminants. The SSO or SSO designee may also be required to advise the FOL on other safety-related matters regarding sampling, such as mitigative measures to address potential hazards from hazardous objects or conditions.

Project Geologist/Sampler - The project geologist/sampler is responsible for the proper acquisition of samples in accordance with this SOP or other project-specific documents. In addition, this individual is responsible for the completion of all required paperwork (e.g., sample log sheets, field notebook, boring logs, container labels, custody seals, and chain-of-custody forms) associated with the collection of those samples.

Project Hydrogeologist – This individual is responsible for selecting and detailing the specific groundwater sampling techniques, onsite water quality testing (type, frequency, and location), equipment to be used, and providing detailed input in this regard to the project planning documents. The project hydrogeologist is also responsible for properly briefing and overseeing the performance of site sampling personnel.

Field Operations Leader (FOL) – This individual is primarily responsible for the execution of the planning document containing the Sampling and Analysis Plan (SAP). This is accomplished through management of a field sampling team for the proper acquisition of samples. He or she is responsible for the supervision of onsite analyses; ensuring proper instrument calibration, care, and maintenance; sample collection and handling; the completion and accuracy of all field documentation; and making sure that custody of all samples obtained is maintained according to proper procedures. When appropriate and as directed by the FOL, such responsibilities may be performed by other qualified personnel (e.g., field technicians) where credentials and time permit. The FOL is ultimately responsible for adherence to Occupational Safety and Health Administration (OSHA) regulations during these operations through self acquisition or through the management of a field team of samplers.

General personnel qualifications for groundwater sample collection and onsite water quality testing include the following:

- Occupational Safety and Health Administration (OSHA) 40-hour and applicable refresher training.
- Capability of performing field work under the expected physical and environmental (i.e., weather) conditions.

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- Familiarity with appropriate procedures for sample documentation, handling, packaging, and shipping.

5.0 HEALTH AND SAFETY

Specific safety and health precautions are identified throughout this SOP. In addition to those precautions, the following general hazards may be incurred during sampling activities:

- Knee injuries from kneeling on hard surfaces
- Slips, trips, and falls
- Cuts and lacerations
- Traffic hazards associated with sampling in parking areas and roadways and along highways.

Methods of avoiding these hazards are provided below.

Knee injuries – Many monitoring wells are installed as flush mounts. Personnel are required to kneel to open these wells and to take groundwater level measurements, etc. This could result in knee injuries from kneeling on stones/foreign objects and general damage due to stress on the joints. To combat this hazard:

- Clear any foreign objects from the work area.
- Wear hard-sided knee pads.

Slips, Trips, and Falls – These hazards exist while traversing varying terrains carrying equipment to sample wells. To minimize these hazards:

- Pre-survey well locations. Eliminate, barricade, or otherwise mark physical hazards leading to the locations.
- Carry small loads that do not restrict the field of vision.
- Travel the safest and clearest route (not necessarily the shortest).

Cuts and Lacerations – To prevent cuts and lacerations associated with groundwater sampling, the following provisions are required:

- Always cut away from yourself and others when cutting tubing or rope. This will prevent injury to yourself and others if the knife slips.
- Do not place items to be cut in your hand or on your knee.
- Change blades as necessary to maintain a sharp cutting edge. Many accidents result from struggling with dull cutting attachments.
- Whenever practical, wear cut-resistant gloves (e.g., leather or heavy cotton work gloves) at least on the hand not using the knife.
- Keep cutting surfaces clean and smooth.
- Secure items to be cut -- do not hold them against the opposing hand, a leg, or other body part.

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- When transporting glassware, keep it in a hard-sided container such as a cooler so that if there is a fall, you will be less likely to get cut by broken glass.
- DO NOT throw broken glass or glass ampoules into garbage bags. Place broken glass and glass ampoules in hard-sided containers such as a cardboard box or directly into a dumpster. DO NOT reach into garbage bags to retrieve any item accidentally thrown away. Empty the contents onto a flat surface to avoid punctures and lacerations from reaching where you cannot see.

Vehicular and Foot Traffic Hazards – When sampling along the roadway or near traffic patterns, follow the following precautions:

- Motorists may be distracted by onsite activities – ASSUME THEY DO NOT SEE YOU OR MEMBERS OF YOUR FIELD CREW.
- DO NOT place obstructions (such as vehicles) along the sides of the road that may cause site personnel to move into the flow of traffic to avoid your activities or equipment or that will create a blind spot.
- **Provide a required free space of travel.** Maintain at least 6 feet of space between you and moving traffic. Where this is not possible, use flaggers and/or signs to warn oncoming traffic of activities near or within the travel lanes.
- **Face Traffic.** Whenever feasible, if you must move within the 6 feet of the required free space or into traffic, attempt to face moving traffic at all times. Always leave yourself an escape route.
- Wear high-visibility vests to increase visual recognition by motorists.
- Do not rely on the vehicle operator's visibility, judgment, or ability. Make eye contact with the driver. Carefully and deliberately use hand signals so they will not startle or confuse motorists or be mistaken for a flagger's direction before moving into traffic.
- Your movements may startle a motorist and cause an accident, so move deliberately. Do not make sudden movements that might confuse a motorist.

6.0 PROCEDURES

6.1 General

For information derived from a groundwater sample to be useful and accurate, the sample must be representative of the particular zone being sampled. The physical, chemical, and bacteriological integrity of the sample must be maintained from the time of sampling to the time of analysis to keep any changes in water quality parameters to a minimum.

CAUTION

A closed well may generate and accumulate gases due to biological degradation, evolution of volatile chemicals from groundwater into the air, or other chemical actions. These gases may also be artificially generated, such as in the case of air sparging or extraction wells, which may take several days to depressurize. See Section 6.6.2 for safety measures to be employed to protect sampling personnel.

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Methods for withdrawing samples from completed wells include the use of pumps, compressed air or nitrogen, bailers, and various types of samplers. The primary considerations in obtaining a representative sample of groundwater are to avoid collection of stagnant (standing) water in the well and to avoid physical or chemical alteration of the water sample due to external influences of the sampling technique(s). In a non-pumping well, there will be little or no vertical mixing of water in the well pipe or casing, and stratification will occur. The well water in the screened section will mix with groundwater due to normal flow patterns, but the well water above the screened section will remain isolated and become stagnant. Concentration gradients resulting from mixing and dispersion processes, layers of variable geologic permeability, and the presence of separate-phase product (e.g., floating hydrocarbons) may cause stratification. Excessive pumping or improper sampling methods can dilute or increase contaminant concentrations in the collected sample compared to what is representative of the integrated water column as it naturally occurs at that point, resulting in the collection of a non-representative sample. To safeguard against collecting non-representative samples, the following approach shall be followed prior to sample acquisition:

CAUTION

Mechanical agitation of well water may cause off-gas generation of volatile contaminants, creating an inhalation exposure to the sampler(s). Where avoiding an inhalation exposure is not possible and mechanical agitation is possible, pump into closed-top containers to control potential air emissions.

1. If possible, position yourself (and the sampling equipment) upwind of the well head.
2. Purge the monitoring well to be sampled prior to obtaining any samples from it. Evacuation of three to five well volumes is recommended prior to sampling, unless low-flow purging and sampling methods are utilized as described in Section 6.7 (Consult the site-specific SAP for exact purging parameters). In a high-yielding groundwater formation and where there is no stagnant water in the well above the screened section, extensive evacuation prior to sample withdrawal is not as critical as it is in a low-yielding well or in wells containing stagnant water.
3. For wells with low yields that are purged dry during sampling, evacuate the well and allow it to recover to 75 percent of full capacity prior to sample acquisition. If the recovery rate is fairly rapid (generally 300 mL per minute or greater), attempt to continue evacuation until the number of well volumes specified in the SAP is achieved. If this cannot be accomplished, allow recovery to 75 percent of capacity and begin sampling.

CAUTION

For moderate to high-yielding monitoring wells, an evacuation rate that does not cause excessive turbulence in the well should be selected. There is no absolute safeguard against contaminating the sample with stagnant water; hence, special techniques are required for purging to minimize the potential for sample contamination (see below).

4. For moderate to high-yielding monitoring wells, use one of the following purge techniques:
 - Place a submersible pump or the intake line of a surface pump or bailer just below the water surface when removing the stagnant water.
 - While purging and as the water level decreases, lower the pump or intake line as the water level drops in the well. Three to five volumes of water shall be removed to provide reasonable assurance that all stagnant water has been evacuated. After this is accomplished, a bailer or other approved device may be used to collect the sample for analysis.

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- Unless otherwise directed, place the intake line of the sampling pump (or the submersible pump itself) near the center of the screened section, and pump approximately one casing volume of water from the well at a low purge rate equal to the well's recovery rate (low-flow sampling).

6.2 Sampling, Monitoring, and Evacuation Equipment

Sample containers shall conform to the guidelines in SOP SA-6.1.

The following equipment shall be on hand when sampling groundwater wells (reference SOPs SA-6.1 and SA-7.1):

- Sample packaging and shipping equipment – Coolers for sample shipping and cooling, chemical preservatives, appropriate sampling containers and filler materials, ice, labels, and chain-of-custody documents.
- Field tools and instrumentation
 - Multi-parameter water quality meter with an in-line sample chamber capable of measuring ORP, pH, temperature, DO, specific conductance, turbidity, and salinity, or individual meters (as applicable)
 - pH Paper
 - Camera and film (if appropriate)
 - Appropriate keys (for locked wells)
 - Water level indicator and/or oil-water interface probe if separate-phase product is expected
- Pumps
 - Shallow-well pumps: Centrifugal, bladder, suction, or peristaltic pumps with drop lines and air-lift apparatus (compressor and tubing) where applicable.
 - Deep-well pumps: Submersible pump and electrical power-generating unit, or bladder pumps where applicable.
- Other sampling equipment – Bailers, graduated cylinder, stopwatch, and inert line with tripod-pulley assembly (if necessary).
- Pails – Plastic, graduated.
- Clean paper or cotton towels for cleaning equipment.
- Buckets with lids for collecting purge water.
- Decontamination solutions – Deionized water, potable water, phosphate-free laboratory-grade detergent, and analytical-grade solvent (e.g., pesticide-grade isopropanol), as required.

Ideally, sample withdrawal equipment shall be completely inert, economical, easily cleaned, cleaned prior to use, reusable, able to operate at remote sites in the absence of power sources, and capable of delivering variable rates for well purging and sample collection.

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6.3 Calculations of Well Volume

To ensure that the proper volume of water has been removed from the well prior to sampling, it is first necessary to know the volume of standing water in the well pipe (including well screen where applicable). This volume can be easily calculated by the following method. Calculations shall be entered in the site logbook or field notebook or on a sample log sheet form or equivalent electronic form(s) (see SOP SA-6.3):

1. Obtain all available information on well construction (location, casing, screen, etc.).
2. Determine well or inner casing diameter.
3. Measure and record static water level (depth below ground level or top of casing reference point).
4. Determine depth of well by sounding using a clean, decontaminated, weighted tape measure or water level indicator.
5. Calculate number of linear feet of static water (total depth or length of well pipe minus the depth to static water level).
6. Calculate one static well volume in gallons $V = (0.163)(T)(r^2)$

where: V = Static volume of well in gallons.
T = Linear feet of water in the well.
r = Inside radius of well casing in inches.
0.163 = Conversion factor (compensates for conversion of casing radius from inches to feet and cubic feet to gallons and pi.

7. Per evacuation volumes discussed above, determine the minimum amount to be evacuated before sampling.

Measuring devices may become contaminated when gathering the above information if they are submerged in contaminated water. Decontamination of the tape or water level indicator must be conducted between measurements in different wells as follows:

1. Saturate a paper towel or clean cotton towel with deionized water.
2. As the measuring device is extracted, wipe the tape, changing the cleaning surface frequently.
3. After it is extracted, rinse the probe or tape using a spray bottle of deionized water over a bucket or similar collection container.

Based on the contaminant (oily, etc), it may be necessary to use a soap and water wash and rinse to remove contaminants. Isopropanol can be used on the probe/tape. However, it is recommended that the use of solvents on the tape be minimized because they could degrade the protective covering or possibly remove the scale designations. If isopropanol (or some other solvent) is used, assure that the manufacturer/supplier Material Safety Data Sheet (MSDS) is obtained, kept on site at a readily available location with other MSDSs, and reviewed by personnel prior to the first usage of the solvent. Also, add the substance to the site-specific Hazardous Chemical Inventory list (see Section 5 of the TtNUS Health and Safety Guidance Manual [HSGM], Hazard Communication Program and OSHA Standard 29 CFR 1910.1200).

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6.4 Evacuation of Static Water – Purging

6.4.1 General

The amount to be purged from each well will be determined prior to sample collection. This amount will depend on the intent of the monitoring program and the hydrogeologic conditions. Programs to determine overall quality of water resources may require long pumping periods to obtain a sample that is representative of a large volume of the aquifer. The pumped volume may be specified prior to sampling so that the sample can be a composite of a known volume of the aquifer. Alternately, the well can be pumped until parameters such as temperature, specific conductance, pH, and turbidity (as applicable) have stabilized. Onsite measurements of these parameters shall be recorded in the site logbook or field notebook or on standardized data sheets or an equivalent electronic form(s).

6.4.2 Evacuation Devices

The following discussion is limited to those devices commonly used at hazardous waste sites. Attachment A provides guidance on the proper evacuation device to use for given sampling situations. All of these techniques involve equipment that is portable and readily available.

Bailers

Bailers are the simplest evacuation devices used and have many advantages. They generally consist of a length of tubing equipped with a base plate and ball check-valve at the bottom. Bailers are comprised of stainless steel and plastic. They come in a variety of sizes, but the two most often used are 2 inches and 4 inches in diameter. An inert non-absorbent line such as polyethylene rope is used to lower and then raise the bailer to retrieve the sample. As the bailer is lowered into the water column, the ball is pushed up allowing the tube to be filled. When the bailer is pulled upward, the ball seats in the base plate preventing water from escaping.

Advantages of bailers include the following:

- There are few limitations on size and materials used.
- No external power source is needed.
- Bailers are inexpensive and can be dedicated and hung in a well to reduce the chances of cross-contamination.
- Bailers are relatively easy to decontaminate.

Limitations on the use of bailers include the following:

- It is time consuming to remove stagnant water using a bailer.
- Splashing the bailer into the water or transfer of sample may cause aeration.
- The use of a bailer does not permit constant in-line monitoring of groundwater parameters.
- Use of bailers is physically demanding, especially in warm temperatures at personal protection equipment (PPE) levels above Level D.

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Safety concerns using a bailer include the following:

- Muscle stress and strain, especially when using 4-inch bailers and when pulling from excessively deep wells.
- Entanglement, possible hand/finger injuries, and rope burns during a sudden release of the bailer back down the well.
- Direct contact with contaminants of concern and sample preservatives when discharging the bailer contents because there is not a high level of control during a direct pour, and splashing and indirect contact with contaminants/preservatives could occur.

Control measures for these hazards are provided in Section 6.6.2.

Suction Pumps

There are many different types of inexpensive suction pumps including centrifugal, diaphragm, and peristaltic pumps. Centrifugal and diaphragm pumps can be used for well evacuation at a fast pumping rate and for sampling at a low pumping rate. The peristaltic pump is a low-volume pump that uses rollers to squeeze flexible tubing to create suction. This tubing can be dedicated to a well to prevent cross-contamination from well to well. Suction pumps are all portable, inexpensive, and readily available. However, because they are based on suction, their use is restricted to areas with water levels within 20 to 25 feet of the ground surface. A significant limitation is that the vacuum created by these pumps can cause loss of dissolved gases and volatile organics. Another limitation of these pumps is that they require a secondary energy source to drive them. Electrically driven pumps may require portable generators as energy sources. Air diaphragm pumps require air compressors and/or compressed gas cylinders to drive them. The advantage of the peristaltic pump is that it will operate from a portable battery source. Safety measures associated with these pumps are provided below.

Air-Lift and Gas-Lift Samplers

This group of pump samplers uses gas pressure either in the annulus of the well or in a venturi to force groundwater up a sampling tube. These pumps are also relatively inexpensive. Air- or gas-lift samplers are more suitable for well development than for sampling because the samples may be aerated as a result of pump action. Aeration can cause pH changes and subsequent trace metal precipitation or loss of volatile organics.

Submersible Pumps

Submersible pumps take in water and push the sample up a sample tube to the surface. The power sources for these samplers may be compressed gas or electricity. Operation principles vary, and displacement of the sample can be by an inflatable bladder, sliding piston, gas bubble, or impeller. Pumps are available for 2-inch-diameter wells and larger. These pumps can lift water from considerable depths (several hundred feet).

Limitations of this class of pumps include the following:

- They may have low delivery rates.
- Many models are expensive.

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- Compressed gas or electric power is needed.
- Sediment in water may cause clogging of the valves or eroding of the impellers with some of these pumps.
- Decontamination of internal components can be difficult and time consuming.

Compressed Gases

Safety concerns using compressed gases as an energy source in these pumps are numerous. The nitrogen gas or compressed air is provided in a compressed gas cylinder at a pressure of approximately 2,000 psi. If damaged, these cylinders can become dangerous projectiles. Additionally, a sudden release of a cylinder's contents can involve considerable force that could cause significant damage to the eyes and/or skin. Protective measures include the following:

- Always wear safety impact glasses when handling compressed gases.
- Always administer compressed gases through an appropriate pressure-reducing regulator.
- When clearing the cylinder connection port, open the cylinder valve only enough to clear foreign debris. During this process, always position the cylinder valve so that it faces away from you and others.
- If the cylinder is designed to accept a valve protection cap, always keep that protection cap in place, except the cylinder is connected for use.
- When using the cylinder, lay the cylinder on its side to avoid the potential of it falling and knocking the valve off (and becoming a missile).
- DO NOT use the compressed nitrogen or air to clean clothing or to spray off the skin. Small cuts in the protective layer of the skin may permit the gas to enter into the bloodstream, presenting the potential danger of an embolism.

See the project-specific HASP for additional direction concerning cylinder safe handling procedures pertaining to the safe handling, transportation, and storage of compressed gas cylinders.

Electrical Shock

Even in situations where portable batteries are used, the potential for electrical shock exists. This potential risk is increased in groundwater sampling activities because of the presence of groundwater near the batteries. This potential is also increased in (prohibited) situations where jury-rigging of electrical connections is performed. Other potential hazards occur when field samplers open the hood of a running car to access the battery as a power source. To control these hazards:

- If you are unfamiliar with electrical devices, do not experiment, get help, and get the proper equipment necessary to power your device.
- Use the proper portable power inverters for cigarette lighter connections to minimize the need to access the battery under the hood of your vehicle.
- Use of electrical generators may pose a number of hazards including noise, those associated with fueling, and indirect sample influence.

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To minimize or eliminate electrical generator hazards:

- Inspect the generator before use. Ensure that the generator and any extension cords are rated for the intended operation and have a Ground Fault Circuit Interrupter (GFCI) in line to control potential electrical shock.
- Fuel the generator before purging and sampling to avoid loss of power during sampling.
- Fuel engines only when they are turned OFF and have cooled sufficiently to prevent a fire hazard.
- Place the generator and any fuel source at least 50 feet from the well to be sampled to avoid indirect influence to the sample from fuel vapors or emission gases.

Lifting Hazards

This hazard may be experienced when moving containers of purge water, equipment, cylinders, etc. To control these potential hazards:

- Do not fill purge buckets to more than 80 percent of their capacity.
- Obtain a gas cylinder of sufficient size to complete the designated task but not too large to handle. K-size cylinders weigh approximately 135 pounds and are difficult to handle. M-size cylinders weigh approximately 50 pounds and are easier to handle and move.
- When necessary, get help lifting and moving gas cylinders and other heavy objects. Minimize twisting and turning while lifting. If it is necessary to move these cylinders or generators over significant distance, use mechanical means (carts, etc.).
- Use proper lifting techniques as described in Section 4.4 of the HSGM.

6.5 Onsite Water Quality Testing

This section describes the procedures and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific conductance
- Temperature
- DO
- ORP
- Turbidity
- Salinity

This section is applicable for use in an onsite groundwater quality monitoring program to be conducted at a hazardous or nonhazardous waste site. The procedures and equipment described are applicable to groundwater samples and are not, in general, subject to solution interferences from color, turbidity, or colloidal material or other suspended matter.

This section provides general information for measuring the parameters listed above with instruments and techniques in common use. Because instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use. Most meters

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used to measure field parameters require calibration on a daily basis. Refer to SOP SA-6.3 for an example equipment calibration log.

6.5.1 Measurement of pH

6.5.1.1 General

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment such as acid-base neutralization, water softening, and corrosion control is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken and recorded on the groundwater sample log sheet (Attachment B) or equivalent electronic form.

Two methods are given for pH measurement: the pH meter and pH indicator paper. Indicator paper is used when only an approximation of the pH is required or when pH meter readings need to be verified, and the pH meter is used when a more accurate measurement is needed. The response of a pH meter can be affected by high levels of colloidal or suspended solids, but the effect is generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, or colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. In such cases, use of a pH meter is recommended.

6.5.1.2 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution created by the addition of the water sample reacting with the indicator compound on the paper. Various types of pH papers are available, including litmus (for general acidity or alkalinity determination) and specific, or narrower range, pH range paper.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on establishment of a potential difference across a glass or other type of membrane in response to (in this instance, hydrogen) ion activity (which is usually similar to concentration) across that membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to the ion concentration is generated and measured.

6.5.1.3 Equipment

The following equipment is to be used for obtaining pH measurements:

- A stand-alone portable pH meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Combination electrode with polymer body to fit the above meter. Alternately, a pH electrode and a reference electrode can be used if the pH meter is equipped with suitable electrode inputs.
- Buffer solutions, as specified by the manufacturer. If the buffer solutions are considered hazardous per 29 Code of Federal Regulations (CFR) 1910.1200 (Hazard Communication) or the volumes used are greater than consumer commodity levels, the SSO shall obtain MSDSs from the manufacturer for the specific buffer solutions (see Section 4 of the HSGM regarding the Hazard Communication Program)

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- pH indicator paper to cover the pH range 2 through 12.
- Manufacturer's operation manual. All personnel must be familiar with the equipment operation to ensure that the integrity of samples is preserved and that the equipment is operated safely.

6.5.1.4 Measurement Techniques for Field Determination of pH

pH Meter

The following procedure shall be used for measuring pH with a pH meter (meter standardization is according to manufacturer's instructions):

1. Inspect the instrument and batteries prior to initiation of the field effort.
2. Check the integrity of the buffer solutions used for field calibration. Buffer solutions need to be changed often as a result of degradation upon exposure to the atmosphere.
3. If applicable, make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).
4. Calibrate the meter and electrode(s) on a daily use basis (or as recommended by manufacturer) following manufacturer's instructions. Record calibration data on a water quality meter calibration log sheet (Attachment C) or equivalent electronic form.
5. Immerse the electrode(s) in the sample. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a physical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. The failure of the measurements to stabilize must be clearly noted in the logbook or equivalent electronic form.
6. Read and record the pH of the sample. pH shall be recorded to the nearest 0.01 pH standard unit. Also record the sample temperature (unless otherwise specified in the SAP, record temperatures to the nearest whole degree Fahrenheit or 0.5 degree Celsius).
7. Rinse the electrode(s) with deionized water.
8. Store the electrode(s) in an accordance with manufacturer's instructions when not in use.

Any visual observation of conditions that may interfere with pH measurement, such as oily materials or turbidity, shall be noted and avoided as much as possible.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown the investigation shall start with wide-range paper and proceed with successively narrower range paper until the sample pH is determined. To measure the pH with pH paper:

1. Collect a small portion of sample into a clean container.

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2. Dip the pH paper into this small portion of sample.
3. Compare the color of the paper to the color chart that is provided with the pH paper and read the corresponding pH from the chart.
4. Record the pH value from the chart on the sampling log sheet.
5. Discard the used pH paper as trash.
6. Discard the small volume of sample that was used for the pH measurement with the other investigative derived waste.

6.5.2 Measurement of Specific Conductance

6.5.2.1 General

Conductance provides a measure of dissolved ionic species in water and can be used to identify the direction and extent of migration of contaminants in groundwater or surface water. It can also be used as a measure of subsurface biodegradation or to indicate alternate sources of groundwater contamination.

Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample because temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect specific conductance. Most conductivity meters in use today display specific conductance in units of mS/cm, which is the conductivity normalized to a temperature of 25°C. These are the required units to be recorded on the groundwater sample log field form or equivalent electronic form.

6.5.2.2 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions migrate toward the negative electrode, and the negatively charged ions migrate toward the positive electrode. Most inorganic acids, bases, and salts such as hydrochloric acid, sodium carbonate, and sodium chloride, respectively, are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not dissociate in aqueous solution, conduct a current very poorly if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell may also be used as a measure of conductance. The core element of the apparatus is the conductivity cell containing the solution of interest. Depending on the ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell, which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

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6.5.2.3 Equipment

The following equipment is needed for taking specific conductance measurements:

- Stand-alone portable conductivity meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution, as specified by the manufacturer.
- Manufacturer's operation manual.

A variety of conductivity meters are available that may also be used to monitor salinity and temperature. Probe types and cable lengths vary, so equipment must be obtained to meet the specific requirements of the sampling program.

6.5.2.4 Measurement Techniques for Specific Conductance

The steps involved in taking specific conductance measurements are as follows (calibration shall be conducted according to manufacturer's instructions):

1. Check batteries and calibrate instrument before going into the field.
2. Calibrate on a daily use basis (or as recommended by manufacturer), according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used for calibration.
3. Rinse the cell with one or more portions of the sample to be tested or with deionized water and shake excess water from the cell.
4. Immerse the electrode in the sample and measure the conductivity.
5. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
6. Rinse the electrode with deionized water.

If the specific conductance measurements become erratic, recalibrate the instrument and see the manufacturer's instructions for troubleshooting assistance.

6.5.3 Measurement of Temperature

6.5.3.1 General

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in situ, or as quickly as possible in the field because collected water samples may rapidly equilibrate with the temperature of their surroundings.

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6.5.3.2 Equipment

Temperature measurements may be taken with alcohol-toluene, mercury-filled, dial-type thermometers or combination meters equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22). In addition, various meters such as specific conductance or DO meters that have temperature measurement capabilities may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature at great depths can be performed.

6.5.3.3 Measurement Techniques for Water Temperature

If a thermometer is used to determine the temperature for a water sample, use the following procedure:

1. Immerse the thermometer in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the thermometer shall not be inserted into samples that will undergo subsequent chemical analysis.
2. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

If a temperature meter or probe is used:

1. Calibrate the instrument according to manufacturer's recommendations prior to use.
2. Immerse the meter/probe in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of cross-contamination, the meter/probe shall not be inserted into samples that will undergo subsequent chemical analysis.
3. Record values in a field logbook or on a sample log sheet or equivalent electronic form.

6.5.4 Measurement of Dissolved Oxygen

6.5.4.1 General

DO levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. In addition, the growth of many aquatic organisms and the rate of corrosivity are dependent on DO concentrations. Thus, analysis for DO is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in situ because concentrations may show a large change in a short time if the sample is not adequately preserved.

The monitoring method discussed herein is limited to the use of DO meters. Chemical methods of analysis (i.e., Winkler methods) are available but require more equipment and greater sample manipulation. Furthermore, DO meters using a membrane electrode are suitable for highly polluted waters because the probe is completely submersible and is not susceptible to interference caused by color, turbidity, or colloidal material or suspended matter.

6.5.4.2 Principles of Equipment Operation

DO probes are normally electrochemical cells that have two solid metal electrodes of different nobility immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of highest nobility (the cathode) is positioned at the membrane. When a suitable potential exists between

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the two metals, reduction of oxygen to hydroxide ion (OH^-) occurs at the cathode surface. An electrical current is developed that is directly proportional to the rate of arrival of oxygen molecules at the cathode. This rate is proportional to the oxygen concentration in the water being measured.

Because the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, leaving the surface of the solution undisturbed.

DO probes are relatively unaffected by interferences. Interferences that can occur are reactions with oxidizing gases such as chlorine or with gases such as hydrogen sulfide that are not easily depolarized from the indicating electrode. If a gaseous interference is suspected, it shall be noted in the field logbook and checked if possible. Temperature variations can also cause interference because probes exhibit temperature sensitivity. Automatic temperature compensation is normally provided by the manufacturer. This compensation can counteract some of the temperature effects but not all of them.

6.5.4.3 Equipment

The following equipment is needed to measure DO concentrations:

- A stand-alone portable DO meter or combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Sufficient cable to allow the probe to contact the sample.
- Manufacturer's operation manual.

6.5.4.4 Measurement Techniques for Dissolved Oxygen Determination

DO probes differ as to instructions for use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure DO concentrations:

1. Check the DO meter batteries before going to the field.
2. Condition the probe in a water sample for as long a period as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
3. Calibrate the instrument in the field according to manufacturer's recommendations or in a freshly air-saturated water sample of known temperature.
4. Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
5. Rinse the probe with deionized water.
6. Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane by stirring the sample. Probes without stirrers placed in wells may be moved up and down to achieve the required mixing.

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7. Record the DO content and temperature of the sample in a field logbook or on a sample log sheet or equivalent electronic form.
8. Rinse the probe with deionized water.
9. Recalibrate the probe when the membrane is replaced, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable because sample handling is not involved. This however may not always be practical.

Special care shall be taken during sample collection to avoid turbulence that can lead to increased oxygen solubilization and positive test interferences.

6.5.5 Measurement of Oxidation-Reduction Potential

6.5.5.1 General

ORP provides a measure of the tendency of organic or inorganic chemicals to exist in an oxidized state. The ORP parameter therefore provides evidence of the likelihood of anaerobic degradation of biodegradable organics or the ratio of activities of reduced to oxidized species in the sample.

6.5.5.2 Principles of Equipment Operation

When an inert metal electrode, such as platinum, is immersed in a solution, a potential is developed at that electrode depending on the ions present in the solution. If a reference electrode is placed in the same solution, an ORP electrode pair is established. This electrode pair allows the potential difference between the two electrodes to be measured and is dependent on the concentration of the ions in solution. By this measurement, the ability to oxidize or reduce species in solution may be determined. Supplemental measurements, such as DO, may be correlated with ORP to provide knowledge of the quality of the solution, water, or wastewater.

6.5.5.3 Equipment

The following equipment is needed for measuring the ORP of a solution:

- A combination meter with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Reference solution as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.5.4 Measurement Techniques for Oxidation-Reduction Potential

The following procedure is used for measuring ORP:

1. Check the equipment using the manufacturer's recommended reference solution and check its batteries before going to the field.

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2. Thoroughly rinse the electrode with deionized water.
3. If the probe does not respond properly to the recommended reference solution, verify the sensitivity of the electrodes by noting the change in millivolts when the pH of a test solution is altered. The ORP will increase when the pH of a test solution decreases, and the ORP will decrease when the test solution pH is increased. Place the sample in a clean container and agitate the sample. Insert the electrodes and note that the ORP drops sharply when the caustic is added (i.e., pH increases) thus indicating that the electrodes are sensitive and operating properly. If the ORP increases sharply when the caustic is added, the polarity is reversed and must be corrected in accordance with the manufacturer's instructions or the probe should be replaced.
4. Record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.

6.5.6 Measurement of Salinity

6.5.6.1 General

Salinity is a unitless property of industrial and natural waters. It is the measurement of dissolved salts in a given mass of solution. Most field meters determine salinity automatically from conductivity and temperature. The displayed value will be displayed in either parts per thousand (ppt) or percent (e.g., 35 ppt equals 3.5 percent).

6.5.6.2 Principles of Equipment Operation

Salinity is determined automatically from the meter's conductivity and temperature readings according to algorithms (such as are found in Standard Methods for the Examination of Water and Wastewater). Depending on the meter, the results are displayed in either ppt or percent. The salinity measurements are carried out in reference to the conductivity of standard seawater (corrected to salinity = 35 ppt).

6.5.6.3 Equipment

The following equipment is needed for salinity measurements:

- A multi-parameter water quality meter capable of measuring conductivity and temperature and converting them to salinity (e.g., Horiba U-22 or YSI 600 series).
- Calibration solution as specified by the manufacturer.
- Manufacturer's operation manual.

6.5.6.4 Measurement Techniques for Salinity

The steps involved in taking salinity measurements are as follows (standardization shall be conducted according to manufacturer's instructions):

1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
2. Check batteries and calibrate the meter before going into the field.

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3. Calibrate on a daily use basis, according to the manufacturer's instructions and record all pertinent information on a water quality meter calibration log sheet or equivalent electronic form.
4. Rinse the cell with the sample to be tested. This is typically accomplished as the probe is placed in line during the collection of the purge water up to the time of sample acquisition.
5. Immerse the multi-probe in the sample and measure the salinity. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form.
6. Rinse the probes with deionized water.

6.5.7 Measurement of Turbidity

6.5.7.1 General

Turbidity is an expression of the optical property that causes light to be scattered and absorbed rather than transmitted in a straight line through the sample. Turbidity in water is caused by suspended matter such as clay, silt, or other finely divided organic and inorganic matter and microscopic organisms including plankton.

It is important to obtain a turbidity reading immediately after taking a sample because irreversible changes in turbidity may occur if the sample is stored too long.

6.5.7.2 Principles of Equipment Operation

Turbidity is measured by the Nephelometric Method, which is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the scattered light intensity, the higher the turbidity.

Formazin polymer is used as the reference turbidity standard suspension because of its ease of preparation combined with a higher reproducibility of its light-scattering properties than clay or turbid natural water. The turbidity of a specified concentration of formazin suspension is defined as 40 nephelometric units. This same suspension has an approximate turbidity of 40 Jackson units when measured on the candle turbidimeter. Therefore, nephelometric turbidity units (NTUs) based on the formazin preparation will approximate units derived from the candle turbidimeter but will not be identical to them.

6.5.7.3 Equipment

The following equipment is needed for turbidity measurements:

- A turbidity meter (e.g., LaMotte 2020) that calibrates easily using test cells with standards of 0.0, 1.0, and 10 NTUs, or a combination meter equipped with an in-line sample chamber (e.g., YSI 600 series and Horiba U-22).
- Calibration solution and sample tubes, as specified by the manufacturer.
- Manufacturer's operation manual.

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6.5.7.4 Measurement Techniques for Turbidity

The steps involved in taking turbidity measurements utilizing an electrode (e) or light meter (l) are listed below (standardization shall be done according to manufacturer's instructions):

1. Check the expiration date of the solutions used for field calibration and replace them if they are expired.
2. Check batteries and calibrate the instrument before going into the field.
3. Calibrate on a daily basis according to the manufacturer's instructions, and record all pertinent information on a turbidity meter calibration log sheet (Attachment C) or equivalent electronic form.
4. When using the YSI and/or Horiba U-22, rinse the electrode with one or more portions of the sample to be tested or with deionized water.
5. When using the Lamotte 2020, fill the light meter's glass test cell with approximately 5 mL of sample, screw on the cap, wipe off glass to remove all residue that could intercept the instrument's light beam, place the test cell in the light meter, and close the lid.
6. Immerse the electrode in the sample and measure the turbidity.
7. The reading must be taken immediately because suspended solids will settle over time resulting in a lower, inaccurate turbidity reading.
8. Read and record the results in a field logbook or on a sample log sheet or equivalent electronic form. Include a physical description of the sample, including color, qualitative estimate of turbidity, etc.
9. Rinse the electrode or test cell with deionized water.

6.6 Sampling

6.6.1 Sampling Plan

The sampling approach consisting of the following shall be developed as part of the project planning documents approved prior to beginning work in the field:

- Background and objectives of sampling.
- Brief description of area and waste characterization.
- Identification of sampling locations, with map or sketch, and applicable well construction data (well size, depth, screened interval, reference elevation).
- Intended number, sequence, volumes, and types of samples. If the relative degree of contamination between wells is insignificant, a sampling sequence that facilitates sampling logistics may be followed. Where some wells are known or strongly suspected of being highly contaminated, these shall be sampled last to reduce the risk of cross-contamination between wells. In situations where the well is not well-characterized and the nature or extent of airborne contamination is unknown, it is recommended that head space analysis using a photoionization detector (PID) or flame ionization detector (FID) is performed to rate the wells, sampling from least contaminated to most contaminated.

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Refer to the project-specific HASP for appropriate information and direction on air monitoring requirements.

- Sample preservation requirements.
- Work schedule.
- List of team members.
- List of observers and contacts.
- Other information, such as the necessity for a warrant or permission of entry, requirements for split samples, access problems, location of keys, etc.
- The FOL shall ensure that the sampling method(s) to be employed is accurately represented in the HASP, indicating the types of sampling to be employed and the hazards. If the methods are not accurately represented, the FOL should rectify this with the HASP author.
- The FOL shall ensure that sampling teams understand the sampling approach that they are to follow. Where sampling teams are made up of personnel from multiple locations, personal sampling experiences may vary. Therefore the FOL shall review project-specific requirements, SOPs, and protocol to be followed. The FOL will conduct periodic surveys to ensure that these methods are being completed per his/her direction.

6.6.2 Sampling Methods as Related to Low-Flow Sampling

The collection of a groundwater sample consists of the following steps:

1. Ensure the safety of the sample location. Take a few minutes to evaluate the area for physical hazards (trip hazards, uneven ground, overhanging branches, etc.) and natural hazards (snakes, bees, spiders, etc.) that may exist in the area or that may have constructed nests in the well head. Snakes often like to sun themselves on concrete well pads. Follow provisions in the project-specific HASP and/or HSGM for addressing natural hazards.
2. As indicated earlier, some monitoring wells have the potential to contain pressurized headspace (e.g., through the generation of gases from contaminated groundwater, due to biological processes, degradation of contaminants, or simply based on location such as near a landfill or in areas that intersect lithological abnormalities) or through intentional artificial means such as those associated with air sparging systems. Injection or extraction wells may be artificially pressurized and may remain so for several days after the system has been turned off. This presents a hazard to people opening these wells. The Field Sampling Technician shall employ the following practices to minimize these hazards:
 - Wear safety glasses to protect the eyes. If site-specific observations and conditions indicate that the wells may be pressurized, wear a full-face shield over the safety impact eye protection.
 - DO NOT place your face or any other part of your body over the well when opening because this may place you in a strike zone.
 - Open the well cover at arms length, then step away and allow the well to off gas and stabilize.

Follow directions provided in the project-specific HASP, Work Plan and/or Sampling Plan pertaining to the use of volatile chemical detection equipment (PID or FID) within the breathing zone of the sampler

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during sampling to determine the need to retreat from the work area and/or for the use of respiratory protection (as specified in the HASP).

3. When proper respiratory protection has been donned, sound the well for total depth and water level (using clean equipment) and record these data on a groundwater sampling log sheet or equivalent electronic form; then calculate the fluid volume in the well pipe (as previously described in this SOP). It is imperative that downhole equipment be adequately decontaminated between wells to prevent cross-contamination. Just as sampling occurs from the least contaminated to the most contaminated, it is also recommended that groundwater level measurements be taken in this manner.
4. Calculate volume of well water to be removed as described in Section 6.3.
5. Select the appropriate purging equipment (see Attachment A to this SOP) or as designated within your Work Plan/Sampling Plan. If an electric submersible pump with packer is chosen, go to Step 10.
6. Lower the purging equipment or intake into the well to a short distance below the water level or mid-screen as indicated in project-specific documentation and begin water removal. Remember that some contaminants are "bottom dwellers," and in these cases, project-specific direction may specify placing the intake just above (1 to 2 feet) the well bottom. Secure the pump intake at the well and secure the effluent at the collection container and begin pumping. The pumping rate will be determined based on the decrease in the water level (see Section 6.7) or as directed in your project-specific documents or this SOP. Purge water is generally collected in a 5-gallon bucket or similar open- or closed-top container. To minimize the potential for spills and back injuries, do not fill 5-gallon buckets beyond approximately 80 percent of their capacity. Dispose of purge water as indicated in the planning document(s). Where necessary, slow the pumping rate or lower the pump intake as required to maintain submergence.
7. Estimate the approximate rate of discharge frequently and record it on the Low Flow Purge Data Sheet (see Attachment D). Estimate flow rate by noting the amount of discharge in a bucket or graduated cylinder per unit time using a watch with a second hand or a stopwatch.
8. Observe the peristaltic pump tubing intake for degassing "bubbles." If bubbles are abundant and the intake is fully submerged, this pump is not suitable for collecting samples for volatile organics.
9. Purge a minimum of three to five casing volumes before sampling (or as directed by the site-specific SAP). In low-permeability strata (i.e., if the well is pumped to dryness), one volume will suffice. Allow the well to recover to 75 percent of initial water level before sampling. Do not overfill purge containers because this increases the potential for spills and lifting injuries.
10. If sampling using a submersible pump, lower the pump intake to mid-screen (or the middle of the open section in uncased wells) and collect the sample. If sampling with a bailer, lower the bailer to just below the water surface.
11. For pump and packer assemblies only: Lower the assembly into the well so that the packer is positioned just above the screen or open section. Inflate the packer. Purge a volume equal to at least twice the screened interval (or unscreened open section volume below the packer) before sampling. Packers shall always be tested in a casing section above ground to determine proper inflation pressures for good sealing.
12. If the recovery time of the well is very slow (e.g., 24 hours or greater), sample collection can be delayed until the following day. If the well has been purged early in the morning, sufficient water may be standing in the well by the day's end to permit sample collection. If the well is incapable of producing a sufficient volume of sample at any time, take the largest quantity available and record this

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occurrence in the site logbook or equivalent electronic form. When this occurs, contact the analytical laboratory to alert them that a reduced sample volume(s) will be submitted for analysis.

13. Fill sample containers and preserve and label them as described in SOP SA-6.1. Many sample bottles will contain preservative when they are shipped to the field. In those cases, do not add preservative.
14. Replace the well cap and lock it as appropriate. Make sure the well is readily identifiable as the source of the sample.
15. Process sample containers as described in SOP SA-6.1.
16. Decontaminate equipment as described in SOP SA-7.1.

6.7 Low-Flow Purging and Sampling

6.7.1 Scope and Application

Low-flow purging and sampling techniques may be required for groundwater sampling activities. The purpose of low-flow purging and sampling is to collect groundwater samples that contain "representative" amounts of mobile organic and inorganic constituents in the vicinity of the selected open well interval, at or near natural flow conditions. This minimum-stress procedure emphasizes negligible water level drawdown and low pumping rates to collect samples with minimal alterations in water chemistry. This procedure is designed primarily to be used in wells with a casing diameter of 1 inch or more and a saturated screen length, or open interval, of 10 feet or less. Samples obtained are suitable for analyses of common types of groundwater contaminants (volatile and semivolatile organic compounds, pesticides, polychlorinated biphenyls [PCBs], metals and other inorganic ions [cyanide, chloride, sulfate, etc.]). This low-flow procedure is not designed for collection of non-aqueous phase liquid samples from wells containing light or dense non-aqueous phase liquids (LNAPLs or DNAPLs).

This procedure is flexible for various well construction types and groundwater yields. The goal of the procedure is to obtain a turbidity level of less than 10 NTUs and to achieve a water level drawdown of less than 0.3 foot during purging and sampling. If these goals cannot be achieved, sample collection can take place provided that the remaining criteria in this procedure are met.

6.7.2 Equipment

The following equipment is required (as applicable) for low-flow purging and sampling:

- Adjustable rate submersible pump (e.g., centrifugal or bladder pump constructed of stainless steel or Teflon).
- Disposable clear plastic bottom-filling bailers to be used to check for and obtain samples of LNAPLs or DNAPLs.
- Tubing – Teflon, Teflon-lined polyethylene, polyethylene, polyvinyl chloride (PVC), Tygon, or stainless steel tubing can be used to collect samples for analysis, depending on the analyses to be performed and regulatory requirements.
- Water level measuring device with 0.01-foot accuracy (electronic devices are preferred for tracking water level drawdown during all pumping operations).

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- Interface probe.
- Flow measurement supplies.
- Power source (generator, nitrogen tank, etc.). If a gasoline generator is used, it must be located downwind and at a safe distance from the well so that the exhaust fumes do not contaminate the samples.
- Indicator parameter monitoring instruments – pH, turbidity, specific conductance, and temperature. Use of a flow-through cell is recommended. Optional indicators - ORP, salinity, and DO. A flow-through cell (also referred to as an in-line sample chamber) is required.
- Standards to perform field calibration of instruments.
- Decontamination supplies.
- Logbook(s) and other forms (see Attachments B through D) or equivalent electronic form(s).
- Sample bottles.
- Sample preservation supplies (as required by the analytical methods).
- Sample tags and/or labels.
- Well construction data, location map, field data from last sampling event (if available).
- Field Sampling Plan.
- PID or FID instrument for measuring volatile organic compounds (VOCs) per the HASP.

6.7.3 Purging and Sampling Procedure

1. Open the monitoring well as stated earlier and step away. Prepare sampling equipment while allowing 3 to 5 minutes to allow the water level to reach equilibrium. In situations where VOCs are the primary contaminants of concern, air monitoring of the samplers' breathing zone areas may be required by the HASP (typically with a PID or FID).
2. Measure the water level immediately prior to placing the pump in the well and record the water level on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well.
3. Lower the measuring device further into the well to collect the total depth measurement. Again wait 3 to 5 minutes to allow the well to equilibrate to the initial water level prior to placing the pump or pump intake in the well.
4. Record the total well depth on the Low-Flow Purge Data Form or equivalent electronic form immediately prior to placing the pump or tubing into the well
5. Lower the pump or tubing slowly into the well so that the pump intake is located at the center of the saturated screen length of the well. If possible, keep the pump intake at least 2 feet above the bottom of the well to minimize mobilization of sediment that may be present in the bottom of the well. Collection of turbidity-free water samples may be difficult if there is 3 feet or less of standing water in the well.

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6. Start with the initial pump rate set at approximately 0.1 liter per minute. Use a graduated cylinder and stopwatch to measure the pumping rate. Adjust the pumping rates as necessary to prevent drawdown from exceeding 0.3 foot during purging. If no drawdown is noted, the pump rate may be increased (to a maximum of 0.4 liter per minute) to expedite the purging and sampling event. The pump rate will be reduced if turbidity is greater than 10 NTUs after all other field parameters have stabilized. If groundwater is drawn down below the top of the well screen, purging shall cease or the well shall be pumped to dryness and then allowed to recover before purging continues. Well recovery to 75 percent is necessary prior to sampling. Slow-recovering wells should be identified and purged at the beginning of the workday to maximize field work efficiency. If possible, samples should be collected from these wells within the same workday and no later than 24 hours after the end of purging.
 7. Measure the water level in the well every 5 to 10 minutes using the water level meter. Record the well water level on the Low Flow Purge Data Form (Attachment D) or equivalent electronic form.
 8. Record on the Low Flow Purge Data Form every 5 to 10 minutes the water quality parameters (pH, specific conductance, temperature, turbidity, ORP, DO, and salinity or as specified by the approved site-specific planning document) measured by the water quality meter and turbidity meter. If the cell needs to be cleaned during purging operations, continue pumping (allow the pump to discharge into a container) and disconnect the cell. Rinse the cell with distilled/deionized water. After cleaning is completed, reconnect the flow-through cell and continue purging. Document the cell cleaning on the Low-Flow Purge Data Form or equivalent electronic form.
 9. Estimate the flow rate by noting the amount of discharge in a graduated cylinder per unit time using a watch with a second hand. Remeasure the flow rate any time the pump rate is adjusted and periodically during purging. This will determine if a reduction in rate has occurred due to possible battery depletion.
 10. During purging, check for the presence of bubbles in the flow-through cell. The presence of bubbles is an indication that connections are not tight. If bubbles are observed, check for loose connections and tighten, repair, or replace them as necessary to achieve a tight connection.
 11. Wait until stabilization is achieved, or a minimum of two saturated screen volumes have been removed and three consecutive readings, taken at 5 to 10 minute intervals, are within the following limits, then begin sampling:
 - pH ± 0.2 standard units
 - Specific conductance $\pm 10\%$
 - Temperature $\pm 10\%$
 - Turbidity less than 10 NTUs
 - DO $\pm 10\%$
 12. If the above conditions have not been met after the well has been purged for 4 hours, purging will be considered complete and sampling can begin. Record the final well stabilization parameters from the Low-Flow Purge Data Form onto the Groundwater Sample Log Form or equivalent electronic form.
- NOTE:** VOC samples are preferably collected first, directly into pre-preserved sample containers. Fill all sample containers by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence.
13. If the water column in the pump tubing collapses (water does not completely fill the tubing) before exiting the tubing, use one of the following procedures to collect VOC samples:

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- Collect samples for non-VOC analyses first, then increase the flow rate incrementally until the water column completely fills the tubing, collect the sample for VOCs, and record the new flow rate.
- Reduce the diameter of the existing tubing until the water column fills the tubing either by adding a connector (Teflon or stainless steel) or clamp, which should reduce the flow rate by constricting the end of the tubing. Proceed with sample collection.
- Insert a narrow-diameter Teflon tube into the pump's tubing so that the end of the tubing is in the water column and the other end of the tubing protrudes beyond the pump's tubing, then collect the sample from the narrow diameter tubing.
- Prepare samples for shipping as per SOP SA-6.1.

7.0 REFERENCES

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ATTACHMENT A

PURGING EQUIPMENT SELECTION

Diameter Casing		Bailer	Peristaltic Pump	Vacuum Pump	Air-lift	Diaphragm "Trash" Pump	Submersible Diaphragm Pump	Submersible Electric Pump	Submersible Electric Pump w/Packer
1.25-Inch	Water level <25 feet	X	X	X	X	X			
	Water Level >25 feet	X			X				
2-Inch	Water level <25 feet	X	X	X	X	X	X		
	Water Level >25 feet	X			X		X		
4-Inch	Water level <25 feet	X	X	X	X	X	X	X	X
	Water Level >25 feet	X			X		X	X	X
6-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X
8-Inch	Water level <25 feet				X	X		X	X
	Water Level >25 feet				X			X	X

ATTACHMENT A
PURGING EQUIPMENT SELECTION
PAGE 2

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/L length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
BarCad Systems, Inc.	BarCad Sampler	Dedicated; gas drive (positive displacement)	1.5/16	PE, brass, nylon, aluminum oxide	0-150 with std. tubing	1 liter for each 10-15 feet of submergence	\$220-350	Requires compressed gas; custom sizes and materials available; acts as piezometer.
Cole-Parmer Inst. Co.	Master Flex 7570 Portable Sampling Pump	Portable; peristaltic (suction)	<1.0/NA	(not submersible) Tygon®, silicone Viton®	0-30	670 mL/min with 7015-20 pump head	\$500-600	AC/DC; variable speed control available; other models may have different flow rates.
ECO Pump Corp.	SAMPLifier	Portable; venturi	<1.5 or <2.0/NA	PP, PE, PVC, SS, Teflon®, Tefzel®	0-100	0-500 mL/min depending on lift	\$400-700	AC, DC, or gasoline-driven motors available; must be primed.
Geltek Corp.	Bailer 219-4	Portable; grab (positive displacement)	1.66/38	Teflon®	No limit	1,075 mL	\$120-135	Other sizes available.
GeoEngineering, Inc.	GEO-MONITOR	Dedicated; gas drive (positive displacement)	1.5/16	PE, PP, PVC, Viton®	Probably 0-150	Approximately 1 liter for each 10 feet of submergence	\$185	Acts as piezometer; requires compressed gas.
Industrial and Environmental Analysts, Inc. (IEA)	Aquarius	Portable; bladder (positive displacement)	1.75/43	SS, Teflon®, Viton®	0-250	0-2,800 mL/min	\$1,500-3,000	Requires compressed gas; other models available; AC, DC, manual operation possible.
IEA	Syringe Sampler	Portable; grab (positive displacement)	1.75/43	SS, Teflon®	No limit	850 mL sample volume	\$1,100	Requires vacuum and/or pressure from hand pump.
Instrument Specialties Co. (ISCO)	Model 2600 Well Sampler	Portable; bladder (positive displacement)	1.75/50	PC, silicone, Teflon®, PP, PE, Detrin®, acetal	0-150	0-7,500 mL/min	\$990	Requires compressed gas (40 psi minimum).
Keck Geophysical Instruments, Inc.	SP-81 Submersible Sampling Pump	Portable; helical rotor (positive displacement)	1.75/25	SS, Teflon®, PP, EPDM, Viton®	0-160	0-4,500 mL/min	\$3,500	DC operated.
Leonard Mold and Die Works, Inc.	GeoFilter Small Diameter Well Pump (#0500)	Portable; bladder (positive displacement)	1.75/38	SS, Teflon®, PC, Neoprene®	0-400	0-3,500 mL/min	\$1,400-1,500	Requires compressed gas (55 psi minimum); pneumatic or AC/DC control module.
Oil Recovery Systems, Inc.	Surface Sampler	Portable; grab (positive displacement)	1.75/12	acrylic, Detrin®	No limit	Approximately 250 mL	\$125-160	Other materials and models available; for measuring thickness of "floating" contaminants.
Q.E.D. Environmental Systems, Inc.	Well Wizard® Monitoring System (P-100)	Dedicated; bladder (positive displacement)	1.66/36	PVC	0-230	0-2,000 mL/min	\$300-400	Requires compressed gas; piezometric level indicator; other materials available.

ATTACHMENT A
PURGING EQUIPMENT SELECTION
PAGE 3

Manufacturer	Model Name/Number	Principle of Operation	Maximum Outside Diameter/Length (Inches)	Construction Materials (w/Lines and Tubing)	Lift Range (ft)	Delivery Rates or Volumes	1982 Price (Dollars)	Comments
Randolph Austin Co.	Model 500 Vari-Flow Pump	Portable; peristaltic (suction)	<0.5/NA	(Not submersible) Rubber, Tygon®, or Neoprene®	0-30	See comments	\$1,200-1,300	Flow rate dependent on motor and tubing selected; AC operated; other models available.
Robert Bennett Co.	Model 180	Portable; piston (positive displacement)	1.8/22	SS, Teflon®, Delrin® PP, Viton®, acrylic, PE	0-500	0-1,800 mL/min	\$2,600-2,700	Requires compressed gas; water level indicator and flow meter; custom models available.
Slope Indicator Co. (SINCO)	Model 514124 Pneumatic Water Sampler	Portable; gas drive (positive displacement)	1.9/18	PVC, nylon	0-1,100	250 mL/flushing cycle	\$250-350	Requires compressed gas; SS available; piezometer model available; dedicated model available.
Solinst Canada Ltd.	5W Water Sampler	Portable; grab (positive displacement)	1.9/27	PVC, brass, nylon, Neoprene®	0-330	500 mL	\$1,300-1,800	Requires compressed gas; custom models available.
TIMCO Mfg. Co., Inc.	Std. Bailer	Portable; grab (positive displacement)	1.66/Custom	PVC, PP	No limit	250 mL/ft of bailer	\$20-60	Other sizes, materials, models available; optional bottom-emptying device available; no solvents used.
TIMCO	Air or Gas Lift Sampler	Portable; gas drive (positive displacement)	1.66/30	PVC, Tygon®, Teflon®	0-150	350 mL/flushing cycle	\$100-200	Requires compressed gas; other sizes, materials, models available; no solvents used.
Tole Devices Co.	Sampling Pump	Portable; bladder (positive displacement)	1.38/48	SS, silicone, Delrin®, Tygon®	0-125	0-4,000 mL/min	\$800-1,000	Compressed gas required; DC control module; custom built.

Construction Material Abbreviations:

PE Polyethylene
 PP Polypropylene
 PVC Polyvinyl chloride
 SS Stainless steel
 PC Polycarbonate
 EPDM Ethylene-propylene diene (synthetic rubber)

Other Abbreviations:

NA Not applicable
 AC Alternating current
 DC Direct current

NOTE: Other manufacturers market pumping devices which could be used for groundwater sampling, though not expressly designed for this purpose. The list is not meant to be all-inclusive and listing does not constitute endorsement for use. Information in the table is from sales literature and/or personal communication. No skimmer, scavenger-type, or high-capacity pumps are included.

Source: Barcelona et al., 1983.

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 GROUNDWATER SAMPLE
 ACQUISITION AND ONSITE
 WATER QUALITY TESTING

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GROUNDWATER SAMPLE ACQUISITION AND ONSITE WATER QUALITY TESTING

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2

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04/07/2008

LOW FLOW PURGE DATA SHEET



PROJECT SITE NAME: _____
PROJECT NUMBER: _____

WELL ID.: _____
DATE: _____

[illegible]

SIGNATURE(S): _____

PAGE__OF__

Appendix C

Field Reports and Logs



Page ____ of ____

BORING No.: _____
DATE: _____
GEOLOGIST: _____
DRILLER: _____

* When rock coring, enter rock brokenness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks:

Drilling Area
Background (ppm):

Converted to Well:	Yes	No	Well I.D. #:
--------------------	-----	----	--------------



Project Site Name: _____
Project No.: _____

- ☐ Surface Soil
☐ Subsurface Soil
☐ Sediment
☐ Other: _____
☐ QA Sample Type: _____

Sample ID No.: _____
Sample Location: _____
Sampled By: _____
C.O.C. No.: _____

Type of Sample:
☐ Low Concentration
☐ High Concentration

GRAB SAMPLE DATA:

Date:	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:**MAP:**

--	--

Circle if Applicable:**Signature(s):**

MS/MSD

Duplicate ID No.: _____



Tetra Tech NUS, Inc.

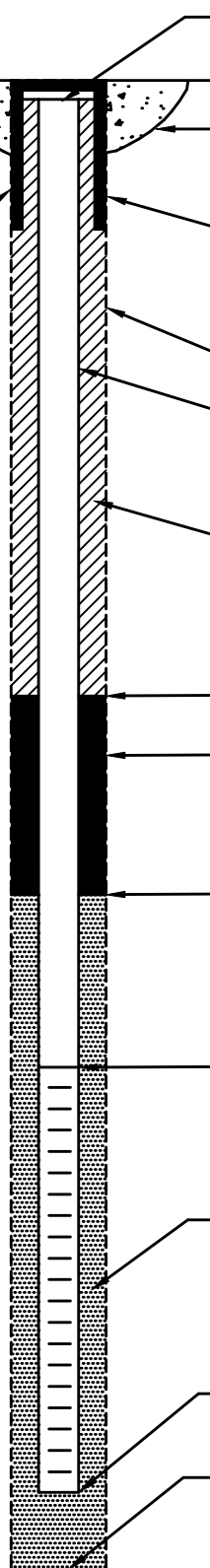
OVERBURDEN MONITORING WELL SHEET FLUSH - MOUNT

WELL NO.: _____

PROJECT _____	LOCATION _____	DRILLER _____
PROJECT NO. _____	BORING _____	DRILLING METHOD _____
DATE BEGUN _____	DATE COMPLETED _____	DEVELOPMENT METHOD _____
FIELD GEOLOGIST _____		
GROUND ELEVATION _____	DATUM _____	

ACAD: FORM_MWFM.dwg 07/20/99 INL

FLUSH MOUNT
SURFACE CASING
WITH LOCK



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

ELEVATION/DEPTH TOP OF SEAL: _____ /

TYPE OF SEAL: _____

ELEVATION/DEPTH TOP OF SAND: _____ /

ELEVATION/DEPTH TOP OF SCREEN: _____ /

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

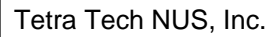
DIAMETER OF HOLE IN BEDROCK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____ /

ELEVATION / DEPTH BOTTOM OF SAND: _____ /

ELEVATION/DEPTH BOTTOM OF HOLE: _____ /

BACKFILL MATERIAL BELOW SAND: _____



Page ____ of ____

[illegible]



Page__ of __

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	



WELL ID.: _____
DATE: _____

SIGNATURE(S): _____

QA SAMPLE LOG SHEET

Page__ of __

Project Site Name: _____ Project Number: _____ Sample Location: _____ QA Sample Type: _____		Sample ID Number: _____ Sampled By: _____ C.O.C. Number: _____	
<input type="checkbox"/> Trip Blank <input type="checkbox"/> Source Water Blank		<input type="checkbox"/> Rinsate Blank <input type="checkbox"/> Other Blank _____	
SAMPLING DATA:		WATER SOURCE:	
Date: _____ Time: _____ Method: _____		<input type="checkbox"/> Laboratory Prepared <input type="checkbox"/> Tap <input type="checkbox"/> Purchased <input type="checkbox"/> Fire Hydrant <input type="checkbox"/> Other _____	
PURCHASED WATER INFORMATION (If Applicable as Source or Rinsate Water):		RINSATE INFORMATION (If Applicable):	
Product Name: _____ Supplier: _____ Manufacturer: _____ Order Number: _____ Lot Number: _____ Expiration Date: _____		Media Type: _____ Equipment Used: _____ Equipment Type: _____ <input type="checkbox"/> Dedicated <input type="checkbox"/> Reusable	
SAMPLE COLLECTION INFORMATION:			
Analysis	Preservative	Container Requirements	Collected
Volatiles	Cool 4°C & HCl		YES / NO
Semivolatiles	Cool 4°C		YES / NO
Pesticide / PCB	Cool 4°C		YES / NO
Metals	Cool 4°C & HNO ₃		YES / NO
Cyanide	Cool 4°C & NaOH		YES / NO
OBSERVATIONS / NOTES:			
<div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto;"> Signature(s): </div>			



EQUIPMENT CALIBRATION LOG

PROJECT NAME : _____

INSTRUMENT NAME/MODEL: _____

SITE NAME: _____

MANUFACTURER: _____

PROJECT No.: _____

SERIAL NUMBER: _____

[illegible]

Appendix D

XRF Specification Sheet

INSTRUCTION MANUAL

INNOV-X SYSTEMS X-RAY FLUORESCENCE SPECTROMETERS

October 2002

Version 1.1

INNOV-X Systems, Inc.

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Woburn, MA 01801

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1.0 INSPECTING YOUR INNOV-X ANALYZER

Upon receipt:

1. Locate and remove the shipping papers and documentation from under the lid's foam padding.
2. Remove the INNOV-X Analyzer and all of the components from the protective carrying case and identify each on the enclosed shipping list.
3. Connect the battery charger to an 110V-240V AC power source. Place one Li-ion battery on the charger and charge it for at least 2 hours. Charge the second battery.
4. Charge the Compaq iPAQ using attached AC adaptor for at least ½ hour.
5. Read and review the "Quick Start" section of the User's Manual. Innov-X recommends that you read the entire manual.
6. Install the fully charged battery into the analyzer
7. Press the ON/OFF button on the base of the pistol grip on the analyzer and the power button on the IPAQ
8. Select the desired analytical mode (i.e., Analytical, Fast ID, Pass/Fail or Soil). The instrument will undergo an approximately 3 minute warm-up period.
9. Standardize the instrument with the 316 Stainless Steel mask. Standardize the instrument every 4 hours or as directed by the display.
10. If possible, analyze a sample of known composition, in order to verify the correct operation of the analyzer.
11. Analyze samples of unknown metal composition.

Note: If your analyzer has not been used for a week or more, you may have to charge the internal iPAQ Pocket PC battery as well. Please see Section 4.4 for instructions to recharge the iPAQ Pocket PC battery.

1.1 COMPONENTS INCLUDED WITH THE ANALYZER

Shown here are the various items which are included in the Innov-X portable XRF analyzer. All items shown are included with every analyzer, with the exception of the test stand, which is an optional accessory.



Analyzer, with iPAQ attached.



Two, Li-ion batteries (one shown).



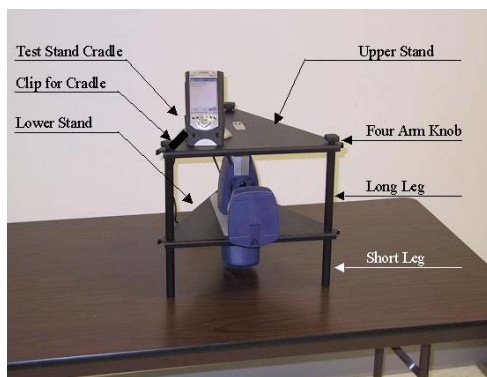
Battery charger and an AC adaptor. Battery shown mounted in charging system.



Standardization cap and mask for weld analysis.



IPAQ cradle and AC adapter. The cradle is used to connect the iPAQ to a PC for downloading data and reports.



Testing stand. This is the benchtop docking station for the analyzer. This accessory is standard with the XT-260 and the XT-440 (environmental analyzer).

1.2 QUICK START INSTRUCTIONS

The following section provides a quick overview to using your Innov-X portable XRF analyzer. This is intended to provide basic startup and operational instruction to perform basic alloy analysis. We highly recommend you read the sections on Radiation Safety (Chapter 2) and the detailed description on operation (Chapter 3). This following Quick Start pages are also available as a separate, bound, laminated publication as a stand-alone Quick Start Guide as well.

Power-On Procedure

1. Be sure Pocket PC is plugged attached to instrument body. This is the standard configuration for shipping from the factory.
2. Turn Main Power – ON; The switch is located at the base of the instrument.
3. Generally the Compaq IPAQ Pocket PC will also power on automatically unless. If the screen remains blank, press the small button on the top right of the Pocket PC to power ON.
4. Tap Microsoft icon at upper left corner of iPAQ.
5. Tap Innov-X logo to start software. You may see a message stating “Connecting to Host”. Ignore this – it is an internal feature of Microsoft Windows operating system.
6. Read User Authorization Dialogue Box & Choose “START”
7. Select desired analysis by tapping name on menu or by choosing Mode (bottom of screen) and then choose the desired mode from the drop-down menu.

e.g. **Alloy Analysis**

Fast ID
Pass/Fail
Analytical

Soil Mode

Note: Modes that are available on the analyzer are in blue, modes that are not available are in light gray.

8. The system will proceed with an automatic warm-up process requiring approximately 2 minutes. System will display bar graph indicating warm-up progress, with message stating “Initializing Hardware...”
9. Release manual trigger lock
10. Standardize on solid side of welding mask.
11. Remove mask, test alloy standard to check instrument performance
12. Place INNOV-X instrument on the test item, squeeze the trigger to begin test

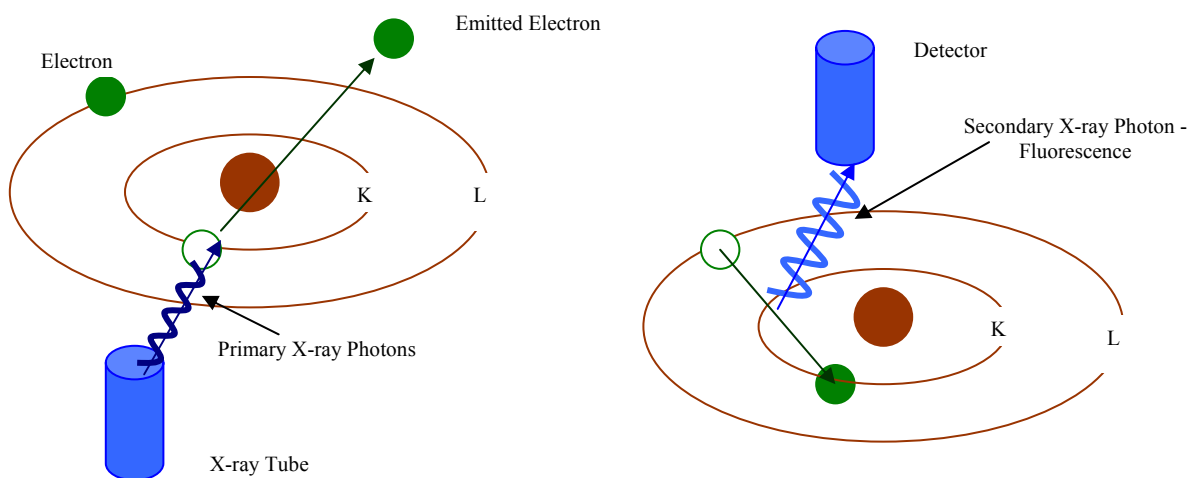
1.3 INTRODUCTION TO XRF: X-RAY FLUORESCENCE SPECTROMETRY OVERVIEW

Basic Theory

Although most commonly known for diagnostic use in the medical field, the use of x-rays forms the basis of many powerful analytical measurement techniques, including X-ray Fluorescence (XRF) Spectrometry.

XRF Spectrometry is used to identify elements in a substance and quantify the amount of those elements present. An element is identified by its characteristic X-ray emission wavelength (λ) or energy (E). The amount of an element present is quantified by measuring the intensity of its characteristic line. XRF Spectrometry ultimately determines the elemental composition of a material.

All atoms have a fixed number of electrons (negatively charged particles) arranged in orbitals around the nucleus. The number of electrons in a given atom is equal to the number of protons (positively charged particles) in the nucleus; and, the number of protons is indicated by the Atomic Number in the Periodic Table of Elements. Each Atomic Number is assigned an elemental name, such as Iron (Fe), with Atomic Number 26. Energy Dispersive (ED) XRF and Wavelength Dispersive (WD) XRF Spectrometry typically utilize activity in the first three electron orbitals, the K, L, and M lines, where K is closest to the nucleus. Each electron orbital corresponds to a specific and different energy level for a given element.



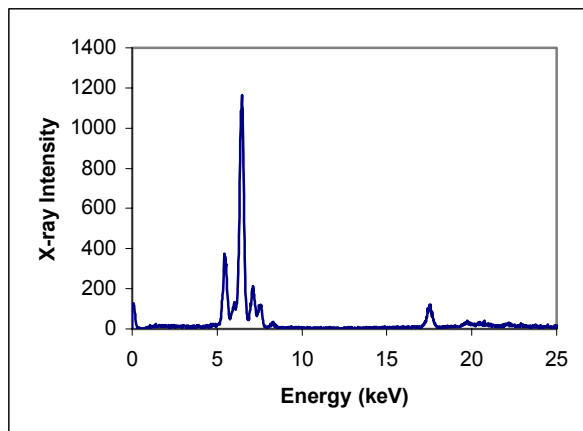
In XRF Spectrometry, high-energy primary X-ray photons are emitted from a source (X-ray tube) and strike the sample. The primary photons from the X-ray tube have enough energy to knock electrons out of the innermost, K or L, orbitals. When this occurs, the atoms become ions, which are unstable. Electrons seek stability; therefore, an electron from an outer orbital, L or M, will move into the newly vacant space at the inner orbital. As the electron from the outer orbital moves into the inner orbital space, it emits an energy known as a secondary X-ray photon. This phenomenon is called fluorescence. The secondary X-ray produced is characteristic of a specific element. The energy (E) of the emitted fluorescent X-ray photon is determined by the difference in energies between the initial and final orbitals of the individual transitions.

This is described by the formula

$$E=hc/\lambda$$

where h is Planck's constant; c is the velocity of light; and λ is the characteristic wavelength of the photon.

Wavelengths are inversely proportional to the energies; they are characteristic for each element. For example the $K\alpha$ energy for Iron (Fe) is about 6.4keV. The number of element-specific characteristic X-rays produced in a sample over a given period of time, or the intensity, can be measured to determine the quantity of a given element in a sample. Typical spectra for EDXRF Spectrometry appear as a plot of Energy (E) versus the Intensity (I).



History

Wilhelm Roentgen discovered X-rays in 1895. Methods for identifying and quantifying elements using XRF were first published by Henry Moseley in 1913. Much research and development of XRF continued after Moseley's pioneering work, especially during WWII when rapid developments in the aircraft, automotive, steel and other metals industries heightened the need to identify alloys quickly and reliably. However, the first commercial XRF Spectrometers weren't available until the early 1950's. Those systems were based on WDXRF technology and measured the characteristic wavelength of an element, one element at a time. Although the use of these systems was critical for elemental analyses, they were large, expensive, and required highly skilled operators to use and maintain them.

In the late 1960's, EDXRF technology, which measures the characteristic energy of an element, began to rival the use of WDXRF due to the development of Si (Li) solid state detectors, which offered better energy resolution of the signal. EDXRF systems offered the potential of collecting and displaying information on all of the elements in a sample at the same time, as opposed to one at a time with typical WDXRF systems. Many of the early EDXRF systems used radioisotopes for excitation instead of X-ray tubes, which could require changing sources to determine all the elements of interest. Some of those early EDXRF systems did not easily resolve multiple elements in a single analytical run.

As can be imagined, the equipment and applications of XRF Spectrometers have developed tremendously since the 1960's. Advancements in technology, electronics, computers, software and the use and modification of them for XRF Spectrometers by instrument manufacturers, research scientists & engineers, and industrial users alike have led to the current state of the art in XRF Spectrometers. Now a mature technology, XRF Spectrometry is routinely used for R&D, QC and analytical services in support of production.

Elemental Analysis

XRF Spectrometry is the choice of many analysts for elemental analysis when compared to the other techniques available. Wet chemistry instrument techniques for elemental analysis require destructive and time-consuming specimen preparation, often using concentrated acids or other hazardous materials. Not only is the sample destroyed, waste streams are generated during the analytical process that need to be disposed of, many of which are hazardous. These wet chemistry elemental analysis techniques often take

twenty minutes to several hours for specimen preparation and analysis time. All of these factors lead to a relatively high cost per sample. However, if PPB and lower elemental concentrations are the primary measurement need, wet chemistry instrument elemental analysis techniques are necessary.

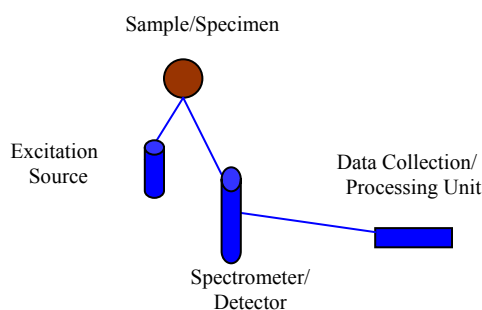
XRF Spectrometry easily and quickly identifies and quantifies elements over a wide dynamic concentration range, from PPM levels up to virtually 100% by weight. XRF Spectrometry does not destroy the sample and requires little, if any, specimen preparation. It has a very fast overall sample turnaround time. These factors lead to a significant reduction in the per sample analytical cost when compared to other elemental analysis techniques.

All elemental analysis techniques experience interferences, both chemical and physical in nature, and must be corrected or compensated for in order to achieve adequate analytical results. Most wet chemistry instrument techniques for elemental analysis suffer from interferences that are corrected for by both extensive and complex specimen preparation techniques, instrumentation advancements, and by mathematical corrections in the system's software. In XRF Spectrometry, the primary interference is from other specific elements in a substance that can influence (matrix effects) the analysis of the element(s) of interest. However, these interferences are well known and documented; and, instrumentation advancements and mathematical corrections in the system's software easily and quickly correct for them. In certain cases, the geometry of the sample can effect XRF analysis, but this is easily compensated for by grinding or polishing the sample, or by pressing a pellet or making glass beads.

Quantitative analysis for XRF Spectrometry is typically performed using Empirical Methods (calibration curves using standards similar in property to the unknown) or Fundamental Parameters (FP). FP is frequently preferred because it allows elemental analysis to be performed with no standards or calibration curves. This enables the analyst to use the system immediately, without having to spend additional time setting up individual calibration curves for the various elements and materials of interest. The capabilities of modern computers allow the use of this no-standard mathematical analysis, FP, accompanied by stored libraries of known materials, to determine not only the elemental composition of an unknown material quickly and easily, but even to identify the unknown material itself.

EDXRF Spectrometers

EDXRF Spectrometer systems mechanically very simple; essentially there are no moving parts. An EDXRF system typically has three major components: an excitation source, a spectrometer/detector, and a data collection/processing unit. The ease of use, rapid analysis time, lower initial purchase price and substantially lower long-term maintenance costs of EDXRF Spectrometers have led to having more systems in use today worldwide than WDXRF Spectrometer systems.



EDXRF has been found most useful for scrap alloy sorting, forensic science, environmental analysis, archaeometry and a myriad of other elemental field-oriented analyses.

Handheld EDXRF Spectrometers for Field Analyses

It is clear that a future trend for elemental analysis is in rapid site investigation using techniques that are fast, inexpensive, reliable, and long-term cost effective. There is a need for immediate decisions to be

made during the delivery of materials, industrial processing, and in the field for positive materials identification or environmental site assessment and remediation. It is also clear that EDXRF Spectrometry is the most suitable elemental analysis technique available for field analysis due to its simplicity, speed, precision, accuracy, reliability, and overall cost effectiveness.

Recent technological developments in cell phones, pocket PC's and other portable consumer electronics have led to the advancement of many high-performance, miniature components. X-ray equipment manufacturers began to take advantage of these developments in the late 1990's and developed Handheld EDXRF systems. An obvious advantage of Handheld EDXRF systems is that the analyzer is taken to the sample as opposed to bringing the sample to the analyzer and configuring it to fit in an analysis chamber. In addition to the per sample analytical cost savings, a key factor in using non-destructive EDXRF analysis, especially in the field, is the overall project cost savings due to improved and more timely decision making. The use of EDXRF for immediate positive materials identification or to guide an environmental site characterization will generally reduce the overall time required in the field due to the quick turnaround for the sample analysis; this invariably reduces the overall costs of analytical field work.

Of course, Handheld EDXRF technology has continued to evolve in concert with portable consumer electronic developments. Just like the early Benchtop EDXRF systems, early Handheld EDXRF systems used radioisotopes for excitation. There are several practical problems with the use of radioactive isotopes for handheld systems. The source decays and loses its testing speed over time. In addition to the loss in analytical capabilities, the sources have to be replaced incurring a cost. The use of radioactive isotopes also requires licensing (state-to-state in the US) and a radioactive materials control program; they are difficult to ship and transport, as they require hazardous materials declarations and/or permits. Consequently, the newest and most exciting development in Handheld EDXRF technology is the use of battery operated, miniature X-ray tubes, which was pioneered by the staff at Innov-X Systems.

Innov-X Systems Handheld EDXRF Spectrometers

Innov-X Systems specializes in Handheld EDXRF technology with the most advanced miniature components available for X-ray Tube sources, detectors, and PC 's. Innov-X Systems Handheld EDXRF Spectrometers are ideally suited for field analysis of alloys, lead-based paint, environmental soils, filters, dust wipes, forensics, archaeometry, and a variety of other elemental analyses in the field or around the plant. Innov-X Systems EDXRF Spectrometers are affordable, easy to use, reliable, and overall cost effective. The Innov-X Systems Handheld EDXRF units incorporate state-of-the-art components including a battery operated miniature X-ray tube, a high-resolution silicon pin detector, high speed data acquisition circuitry, and a Compaq IPAQ Pocket PC® handheld computer for calculations, results and operator interface.

Innov-X Systems EDXRF Spectrometers offer the following invaluable features:

- Portable
- Battery operated - rechargeable
- X-ray Tube-based (Ag anode, 10-35kV, 10-100uA)
- Si PIN diode detector (<250eV FWHM @5.90keV)
- Integrated pocket PC
- Pistol-shaped design for difficult testing locations and welds
- Auto-compensation for irregular or small samples
- Fundamental Parameters for no-standard analyses
- Stored Grade Libraries for rapid Grade ID's
- Stored Fingerprint Libraries for rapid material ID's
- Docking station available for use as standard benchtop unit
- Sample results within a few minutes after a few seconds of irradiation time

For more information on how to utilize your Innov-X Systems Handheld EDXRF Spectrometer optimally, please review this Instruction Manual or contact us directly.

3.0 Radiation Safety

3.0 IMPORTANT SAFETY INFORMATION

THE XRF SHOULD NOT BE POINTED AT ANYONE OR ANY BODY PART, ENERGIZED OR DE-ENERGIZED! The safe and proper operation of the INNOV-X XRF instruments is the highest priority. These instruments produce ionizing radiation and should **ONLY** be operated by individuals, who have been trained by INNOV-X Systems, Inc. and documented by a manufacturer's training certificate. INNOV-X recommends that operators and companies implement a written Radiation Safety Program, with safety components specific to the site and application of use of the instrument. The Radiation Safety Program should be reviewed annually and revised appropriately by a competent individual.

3.1 GENERAL SAFETY PRECAUTIONS

Retain and follow all product safety and operating instructions. Observe all warnings on the product and in the operating instructions. To reduce the risk of bodily injury, electric shock, fire and damage to the equipment, observe the following precautions:

Heed service markings. Except as explained in this documentation, do not service any INNOV-X product yourself. Opening or removing covers may expose you to electric shock. Service needed on components inside these compartments should be done only by INNOV-X Systems, INC.

Damage requiring service:

- The power cord, plug or battery contacts for the battery charger are damaged.
- Liquid has been spilled or an object has fallen onto the instrument.
- The instrument has been exposed to rain or water.
- The instrument has been dropped or damaged.
- There are noticeable signs of overheating.
- The instrument does not operate normally when you follow operating instructions.

Safety Precautions:

Use the correct external power source: Ensure that the voltage is appropriate (100V-240 V/ 50-60 Hz) for charging the battery packs. Do not overload an electrical outlet, power strip, or convenience receptacle. The overall load should not exceed 80% of the branch circuit rating.

Use cables and power cords properly:

Plug the battery charger into a grounded electrical outlet that is easily accessible at all times. Do not pull on cords and cables. When unplugging the cord from the electrical outlet, grasp and pull the cord by the plug.

Handle battery packs properly; do not: disassemble, crush, puncture, short external contacts, dispose of in fire or water, or expose a battery pack to temperatures higher than 60 °C (140 °F). Do not attempt to open or service a battery pack.

<p>WARNING: Danger of explosion if battery is incorrectly substituted. Replace only with INNOV-X specified batteries. Dispose of used batteries in according to the information in the instruction manual supplied with your instrument.</p>

3.2 INNOV-X SYSTEMS – RECOMMENDED RADIATION SAFETY TRAINING COMPONENTS

Individual Companies and States have specific regulations and guidelines for the use of X-ray tube generated ionizing radiation. The purpose of the recommendations below is to provide generic guidance for an ALARA - best practice - approach to radiation safety. These recommendations do not replace the requirement to understand and comply with the specific policies of any state or organization.

1. **Proper Usage.** Never point the instrument at another person. Never point the instrument into the air and perform a test. Never hold a sample in your hand and test that part of the sample.
2. **Establish Controlled Areas.** The location of storage and use should be of restricted access to limit potential exposure to ionizing radiation. In use, the target should not be hand held and the area at least three paces beyond the target should be unoccupied.
3. **Specific Controls.** The instrument should be stored, in a locked case, or locked cabinets when not in use. When in use, it must remain in the direct control of a factory trained, certified operator.
4. **Time - Distance - Shielding Policies.** Operators should minimize the time around the energized instrument, maximize the distance from the instrument window, and shoot into high density materials whenever possible. Under no circumstances should the operator point the instrument at themselves or others.
5. **Prevent Exposure to Ionizing Radiation.** - All reasonable measures, including labeling, operator training and certification, and the concepts of time, distance, & shielding, should be implemented to limit radiation exposure to *as low as reasonably achievable* (ALARA).
6. **Personal Monitoring.** Radiation control regulations may require implementation of a radiation monitoring program, where each instrument operator wears a film badge or TLD detector for an initial period of 1 year to establish a baseline exposure record. Continuing radiation monitoring after this period is recommended, but may be discontinued if accepted by radiation control regulators. Please refer to Sect. 3.10 for a list of providers of film badges.

3.3 PERFORMING A TEST FOLLOWING APPROPRIATE RADIATION SAFETY PROCEDURES

Starting up the Analyzer:

When an operator opens the Innov-X software on the iPAQ, he or she will be presented with the display shown below. Provided an operator has received training by an authorized person at the company, or from an authorized Innov-X trainer, they should touch the START icon to begin using the analyzer. From this point the operator is presented with the main menu of the analyzer to choose an operating mode and begin testing (described in Chapter 3). The remainder of this section is dedicated to operational and safety aspects that pertain to safe use and storage of the analyzer.



Starting a test using the trigger.

When the trigger is depressed, the analyzer supplies power to the x-ray tube and opens the shutter to emit x-rays. The analyzer is provided with a trigger lock to prevent the user from accidentally beginning a test. Slide the lock from left to right to lock the trigger.

Recommended Operation: When the system is not in use, slide the trigger lock to the right to “lock” the trigger. This will prevent a person from starting a test accidentally when they grab the analyzer. The location of the trigger lock is shown to the right.

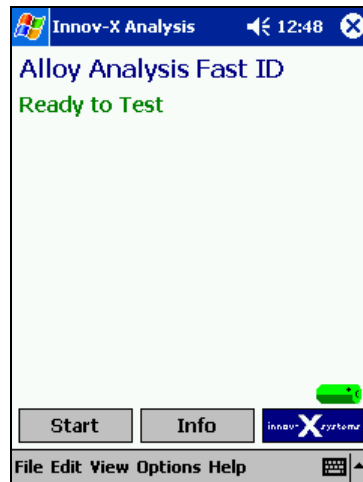
The trigger functions as both an “ON” and “OFF” switch. Touch the trigger once to begin a test. Do NOT hold the trigger as this will immediately stop the test. To end a test manually, press the trigger again.



Figure 3.1 ON/OFF Switch

Starting a Test Using the “Start” Icon on the iPAQ Screen

An operator may also begin a test by pressing the “Start” icon on the touch screen, as shown at the right. The “Start” icon, rather than the trigger, is generally used when the analyzer is docked into the testing stand. As an additional safety feature, the “Start” icon also provides for “two handed” operation of the analyzer. To require two-handed operation, set the trigger lock by sliding the switch left to right. This will require the user to hold the analyzer with one hand and start a test by using the other hand to press the ON switch.



3.4 CORRECT AND INCORRECT INSTRUMENT USAGE:

The Innov-X alloy analyzer can be used in several different testing configurations. Safety guidelines are described for each configuration.

Configuration 1: Handheld Alloy Analyzer:

In this configuration the analyzer is held in the hand, placed on various types of samples and a test is performed. Samples include pipes, valves, large pieces of scrap metal, basically any sample large enough to be tested in place, rather than held in the operator’s hand. Point the instrument at a metal sample such that no part of your body including hands and/or fingers is near the aperture of the analyzer where x-rays are emitted.

Configuration 2: Testing Stand for small samples.

Innov-X strongly recommends that testing small pieces or small samples (rod, fasteners, turnings, XRF sample cups, bagged samples, etc.) be analyzed using the Innov-X Testing Stand. This allows the sample to be placed onto the analysis window of the analyzer without requiring the sample to be held by the operator. See figure below titled “Testing Stand Operation.”



Figure 3.2 Testing Stand Operation. Please refer to Section 6.5 for instructions to assemble the test stand.

Warning: Innov-X strongly recommends that operators do NOT hold samples in their hand for testing. Never hold a small sample in your hand, and test that sample, such that your hand is exposed to the x-ray beam being emitted from the analyzer. This type of testing produces a small but non-negligible radiation dose to the operator's hand. Please see Section 3.5 Radiation Dose Examples for dose levels. See figure below titled "Incorrect Operation."

In the event that an operator insists on testing small parts by holding them in his/her hand, follow the precautionary procedures listed below. We again emphasize that this type of testing is recommended to be performed in a testing stand.

Proper Operation:

Hold the sample such that the operator's hand is not in front of the window of the analyzer, and is at least 3" away from the window. The figure below shows an acceptable means of testing a handheld sample. The operator should also be sure that other personnel are at least 6 feet away from the front end of the analyzer, to avoid any potential exposure. Exposure estimates for various scenarios are presented in the table below.



Figure 3.3. Innov-X always recommends using the testing stand for small parts. However, should an operator require holding a sample in his/her hand for analysis, the operators' hand should be at least 3" away from the instrument window and not in the direct path of the x-ray beam.

Improper Operation, DO NOT TEST SAMPLES LIKE THIS:

Never hold a sample in your hand such that any part of your body or appendages are exposed to the x-ray beam.



Figure 3.4. Example of INCORRECT usage of analyzer for testing small samples. Operators should never hold a sample in their hand to test.

3.5 RADIATION WARNING LIGHTS AND LABELING:

3.5.1 Probe Light and Probe Label:

The Innov-X analyzer is equipped with warning lights that alert the operator when the tube is receiving power, and when x-rays are being emitted from the analyzer. Please see Fig. 3.5 on the next page.

When the red light on the front nose of the analyzer is ON continuously (not blinking), this indicates the x-ray tube is receiving a low level of electrical power and the shutter is closed. The system is producing a low level of x-rays internally in this condition, but the shutter is providing adequate shielding to keep x-ray levels below levels of detection. The instrument is safe to be carried around or set down in this configuration.

When the red light is blinking, this indicates the tube is powered, the shutter is open and the analyzer is emitting x-ray radiation out of the analysis window. The analyzer should only be pointed at a sample, or be in the testing stand with a sample resting on the window, in this configuration.

3.5.2 Testing Light on Back of Analyzer:

The light on the back of the analyzer, shown in Fig. 3.6, is lit while a test is active. During a test – x-ray tube is energized and shutter is open – an LED on the back of the analyzer is lit. This LED remains lit until the test has ended. This light is for testing conditions (i.e. overhead) where the operator cannot see the Probe Light or the iPAQ display. The light turns off when the test is complete. When the light is off, the tube is de-energized and the shutter is closed.

3.5.3 Label Behind iPAQ:

The analyzer also has a label just below the iPAQ indicating, as shown in Figure 3.7:

CAUTION: Radiation. This Equipment Produces Radiation When Energized.

This label is required by most regulatory agencies. The term “When Energized” refers to the condition where the tube is fully energized and the shutter is open. This condition is also indicated by the red blinking light on the probe.



Figure 3.5. Probe light and labeling. When the light is on continuously, the x-ray tube is receiving minimal power and it is producing a minimum level of x-rays. The shutter is also closed so there is no radiation exposure to the operator or bystanders.



Figure 3.6. Back light on analyzer.



Figure 3.7. Label behind iPAQ.

3.6 RADIATION LEVELS FROM ANALYZER

Two pictures of the analyzer are shown below. In the first picture, all the relevant components referenced in this radiation safety section are displayed and labeled. The second picture shows a close-up of the front end of the window. The four sides A, B, C and D are indicated on this picture because they are referenced in terms of radiation levels output by the analyzer. The measured radiation levels for standard operating conditions are shown in the figures and tables below. Standard operating conditions are tube voltage operating at 35 kV, tube current of 30 uA, and 2 mm aluminum filtration.



Figure 3.8 Innov-X Analyzer, Side View



Figure 3.9 Innov-X Analyzer, Front View

Sample at Window	Trigger	Location A (Top)	Location B (Right Side)	Location C (Bottom)	Location D (Left Side)
Blank (Air)	<0.05	2.0	2.1	0.15	1.5
Metal	<0.05	0.6	1.6	<0.05	1.6

Table 3.1. Dose rates at various locations with a metal sample covering the window and with no sample present. For “no sample” the analyzer is shooting the x-ray beam into air.

As shown in the Table 3-1, the dose to the operator’s hand is negligible. The radiation levels at the surface of the instrument snout are a maximum of 2.1 mrem/hour. Provided the operator follows standard operating procedures, there is no reason for any body part to be in the locations denoted A, B, C and D.

Table 3-2 shows the radiation levels directly in the x-ray beam that is emitted from the analyzer. Because the beam is collimated, it does not decline following the usual “r-squared” law. There is no reason for an operator to ever be exposed to this x-ray beam provided he/she is following standard operating procedures. The table entry “Trigger” shows the dose to the operators hand if a test is begun by pointing the analyzer into the air. There is no appreciable dose to the operator in this scenario. Table 2 also shows the dose rate received for a person being in the direct x-ray beam. Again, there is simply no operating procedure that would require an operator or a bystander to receive this dose rate.

Sample at Window	Trigger	At Window	12 inches	24 inches	36 inches	48 inches
Blank (Air)	<0.05	200	50	20	12	6

Table 3.2. Dose rates (units of mrem/hr) in the direct x-ray beam being emitted from the analyzer

3.7 RADIATION DOSES FOR SEVERAL SCENARIOS

In this section we provide data, concrete examples of use and misuse of the analyzer and common questions and answers we encounter when training personnel on the safe use of the Innov-X analyzer. The goals are to a) explain scenarios of safe versus improper usage of the analyzer and b) show that accidental exposures even in extreme situations are very low relative to the allowable dose to workers.

The table below presents radiation doses for normal operating conditions and also for examples of misuse of the analyzer and even extreme misuse. The purpose of these data is to demonstrate that even under conditions of extreme misuse; radiation dose to the operator is quite low relative to maximum allowable levels. Innov-X provides installation training that includes detailed radiation safety training and documentation designed to prevent misuse of the analyzer.

Example of Instrument Usage	Radiation Exposure and Comments
Normal Operation - Dose to Hand: User analyzes samples according to standard operating procedures described in this manual. Assumption: Operator using system with x-ray tube ON for 8 hours/day, 5 days/week, 50 weeks/year. (Practically constant usage).	Maximum exposure is to operator's hand, at the trigger. Exposure is < 0.05 mrem/hr. Annual exposure to hand is then < 100 mrem. Maximum exposure under OSHA regulations is 50,000 mrem annually. Thus continuous operation provides a dose that is at least 500 times lower than maximum allowed by OSHA.
Normal Operation – Dose to Torso: Analyzer is used under the same operating conditions described above.	Exposure to Torso is so low it cannot be measured. It is estimated at < 0.01 mrem/hr. Annual exposure using highly conservative operating conditions above is < 20 mrem. Maximum allowed is 5,000 mrem.
Misuse Example 1: Operator holds samples in front of window with fingers. Fingers not directly in the beam but are placed around the sides of the instrument "nose."	Dose to fingers and/or hand in this example is a maximum of 2.1 mrem/hour. Assume operator performs 100 tests/day in this example, with each test being 30 seconds each, and operator does this 250 days/year. Dose is about 440 mrem/year. Maximum allowed dose is 50,000 mrem/year.
Misuse Example 2: Operator places analyzer against body and pulls the trigger to start a test. Analyzer tests to preset testing time (usually 5-10 seconds) unless operator pulls trigger again to stop test. This applies to analyzer being in contact with operator or with bystander.	Dose at exit of sampling window is approximately 200 mrem/hr. Dose for a 10 second exposure with analyzer in contact with Torso: 0.55 mrem. Thus operator would have to repeat this example of gross misuse 9,000 times in a year to achieve the maximum allowable exposure of 5,000 mrem.
Misuse Example 3: Operator holds small parts in fingers for analysis and exposes fingers and/or hand to x-ray beam at the sampling window.	As in Example 2, dose to fingers is approximately 200 mrem/hr. For a 10 second exposure, the total dose to the fingers or hand is 0.55 mrem. Thus operator would have to misuse analyzer in this fashion 90,000 times to achieve maximum allowed annual exposure.

Misuse Example 4:

In the process of picking up or handling analyzer when it is powered on, operator forgets to lock the trigger and accidentally presses the trigger thus initiating a test. What is exposure to bystander?

Assume the analyzer is powered on for 30 seconds before operator realizes this problem, and assume bystander is actually standing in the x-ray beam at a distance of one foot.

Dose to bystander at 1 foot is 50 mrem/hr. For a 30 second exposure dose is 0.4 mrem. Maximum allowable level is 5,000 mrem assuming bystander's torso is exposed. Thus, this misuse would have to occur 12,500 times in a year to the same bystander before that bystander achieved his maximum allowed dose.

Misuse Example 5:

Operator manages to turn on analyzer and initiate a test, set it aside so it is emitting x-rays, and sets testing time to several hours (as opposed to the 5-30 seconds typical of various applications). What is maximum exposure situation?

Note: This example is almost impossible to conceive of in any real-world scenario. We include it as an example of how even the worse case scenario still does not provide significant exposure to an operator.

After 3 hours of continuous operation, analyzer's battery will be fully discharged. This will shut off analyzer entirely. The analyzer will not be able to produce x-rays until a new battery is provided and system is standardized. Maximum dose to operator is estimated at:

Operator 1 foot from analyzer: 150 mrem.

Operator at sampling window: 600 mrem.

Maximum allowable dose annually is 5,000 rem to torso, 50,000 to extremities.

Comparative: Radiation Doses from Typical Exposures to Ionizing Radiation

Common medical and/or dental x-rays:	20-30 mrem each.
Mammogram:	100-200 mrem
Flying in a commercial jet coast to coast (6 hrs.):	1-2 mrem.
Daily exposure from background radiation: * depends on geographic location	0.3 to 0.5 mrem/day

Table 3.3 Radiation Doses from Typical Exposures to Ionizing Radiation

From the above table, nearly all the cases of analyzer misuse produce radiation exposures similar to flying in a commercial aircraft. Moreover, the typical exposure from a case of significant instrument misuse produces roughly the same dosage as the daily dose of radiation from naturally occurring background radiation.

3.8 COMMON QUESTIONS AND ANSWERS REGARDING RADIATION SAFETY

Question: When I'm shooting a piece of pipe or valve on a rack or on a table top, is there any exposure to people standing in other locations, or standing several feet away from the analyzer?

Answer: Even a thin amount of metal sample (1-2 mm thickness) is enough to completely attenuate the x-ray beam emitted from the Innov-X analyzer. Shooting a piece of material that covers the sampling window on the analyzer will completely shield any bystanders from radiation exposure.

Question: If I forgot to switch the safety on the trigger to "ON", I pick up the analyzer and accidentally pull the trigger, is that dangerous to nearby personnel?

Answer: No, this example of misuse is not dangerous, but it may produce a non-negligible radiation exposure to nearby personnel. For an exposure to occur, the following things must happen. First, you must be holding the analyzer so that a bystander is actually standing in the x-ray beam being emitted. Just being near the analyzer is totally safe otherwise. Second, the bystander must be within 1-3 feet from the nose of the analyzer in addition to being in the beam path, to receive any appreciable dose. If all of these conditions are true, the dose received by a bystander is still extremely low. It ranges between 0.1 to 0.5 mrem depending on the exact location of the bystander. This dose is 10,000 to 50,000 times less than the allowed dose. Please see Misuse Example 4 in the table above.

Question: Do I need to create restricted areas where I am using the analyzer?

Answer: No, provided you are following normal operating procedures there is no reason to restrict access to an area where the analyzer is in use. The operator should take precautions to keep any personnel more than 3 feet away from the sampling window of the analyzer in the event of accidental misuse as detailed above. Should the operator also elect to test small components like weld rod as shown in Figure 3.3, the operator should also be sure that no personnel are standing within about 4-5 feet of the sampling window.

Question: How does the x-ray radiation from this analyzer compare to isotope-based systems?

Answer: The x-ray tube anode and power levels are designed to replicate the output from the typical isotopes used in portable XRF analyzers. Specifically, the output is designed to replicate the Cd-109 isotope and to some degree both the Fe-55 and Am-241 isotopes. By doing this, the analyzer can measure the same range of elements at the three isotopes listed. Moreover, the x-ray output from the analyzer, in units of mrem/hour, is very similar to the output of isotope based instruments. This is because the overall intensity and energy spectrum are designed to be similar to isotope systems.

Question: How does the x-ray tube in the Innov-X system compare to a radiography system used for taking images of metal parts.

Answer: The x-ray tube used in the Innov-X system produces between 1,000 and 10,000 times LESS radiation than most radiography systems. This is because a portable XRF is designed to perform surface analysis of alloys and other samples, whereas radiography systems are designed to shoot x-rays entirely through metal components in order to obtain an image on the other side of the object being bombarded with x-rays. For example, many tube-based radiography systems use a 300-400 kV tube and currents in the tens or hundreds of milliamps (mA). The Innov-X analyzer uses a tube operating at 34 kV and 20-30 micro-amps. The radiation levels produced are therefore thousands or tens of thousands times lower with the Innov-X system.

Question: Should we use dosimeter badges with the Innov-X analyzer.

Answer: Dosimeter badges are required by some states, and optional by other states. Innov-X recommends that operators wear badges, at least for the first year of operation, as a general precaution to flag any misuse of the analyzer. Dosimeter badges are available for the torso (generally worn on the belt loop or shirt pocket) and are available as “ring” badges. The best single badge to obtain is a ring badge that is worn on a finger, on the opposite hand used to hold the analyzer. This will record accidental exposure for the most likely case – an operator grabbing a small sample and holding it in one hand while analyzing it. Note: these badges generally have a threshold of 10 mrem, and are renewed monthly. So it will take several cases of misuse even to obtain a reading on a typical badge. When purchasing a badge, obtain the type used for x-ray and low energy gamma ray radiation.

3.9 SAFE GUARDS AND EMERGENCY RESPONSE

The main safeguards to use as an owner of an Innov-X portable XRF are really intended to restrict access to properly trained operators:

1. Keep the system in a controlled location, where only authorized users are likely to have access to the analyzer at any given time.
2. Make a simple sign that is kept with the analyzer indicating that an operator must have completed a training class provided by your company or must have attended an Innov-X training course in order to use the analyzer. Note that when the Innov-X system is turned on, the screen displays a message indicating that the system should only be used by authorized personnel.

Emergency Response:

Because the Innov-X system is a battery operated, x-ray tube based analyzer, the emergency response plan is very simple. If the operator believes the analyzer is locked up in an “OPEN” position, they should do two things:

1. Press the On/Off switch on the base to power the analyzer off. The green LED indicator will turn off, indicating system power is off. At this point it is not possible for the analyzer to be producing x-rays.
2. As an additional precaution, the operator may remove the battery trap door at the bottom of the analyzer (have the nose pointing away from personnel), and pull out the battery. Even if the operator has failed to properly power the system off in Step #1, removing the battery guarantees that no x-rays can be produced. There is no electrical power being provided to the x-ray tube.

Note: It would be highly unusual for an operator to somehow lock up the analyzer with the x-ray tube powered on. This would require the operator to crash the iPAQ during an analysis. If this happens the analyzer will shut off the x-ray tube 10 seconds after the last communication with the iPAQ. However, if at any time the operator believes the x-ray tube is on and no test is in progress, powering off the analyzer and restarting will automatically shut down the x-ray tube and close the shutter. It will no longer be possible to produce x-rays at this point.

3.10 DOSIMETER BADGES

Dosimeter badges are provided as a monthly service by several companies, listed in this section (see below). The badges are generally provided monthly, and the operator returns the previous month badges to the company for analysis. The operator receives a monthly report showing any personnel with readings higher than typical background radiation.

Dosimeter badges are required by some states, and optional by other states. Innov-X recommends that operators wear badges, at least for the first year of operation, as a general precaution to flag any misuse of the analyzer. Dosimeter badges are available for the torso (generally worn on the belt loop or shirt pocket) and are available as “ring” badges. The best single badge to obtain is a ring badge that is worn on a finger, on the opposite hand used to hold the analyzer. This will record accidental exposure for the most likely case – an operator grabbing a small sample and holding it in one hand while analyzing it. Note: these badges generally have a threshold of 10 mrem, and are renewed monthly. So it will take several cases of misuse even to obtain a reading on a typical badge. When purchasing a badge, obtain the type used for x-ray and low energy gamma ray radiation.

Dosimeter Companies:

Here are two companies that provide badges as a regular service. There are certainly many more.

Landauer Inc.
Glenwood, IL
708-755-7000

AEIL
Houston, TX
713-790-9719

3.11 TYPICAL REGISTRATION REQUIREMENTS

Innov-X maintains a database of the registration requirements for every state, including sample registration forms. Most states require some form of registration, and generally they require the registration to be received within 30 days of receipt of the instrument. Some states require no registration, while a few require notification in advance. Please contact Innov-X for specific questions regarding the state where the instrument will be used, or for copies of registration forms.

In general a company will have to provide the following information regarding the device:

1. Purpose of device. Generally this is “Analytical” or “Industrial.” Be sure to inform the state registration office that the device will NOT be used for radiography or for medical uses.
2. Radiation Safety Officer – Monitors training, safe use, and controls access to the instrument.
3. Authorized Users – Trained by Innov-X Factory Authorized Representatives in the safe and proper use of the XRF.
4. Operating parameters of the analyzer – 35 kV, 30 micro-amps.
5. Type of system, either fixed, mobile or portable. Generally the correct choice is “Portable.”
6. User Training Specified – Indicate that only individuals receiving manufacturer training, documented by a manufacturer’s training certificate will operate the instrument.
7. Personal Monitoring. This may be required by radiation control authorities. Many registration forms will ask that you indicate whether or not you intend to perform dosimeter monitoring.
8. Copy of Registration & Manual at the Job Site

If you have any questions regarding the type of registration form or filling out the form, please contact Innov-X Systems. Many states may confuse a portable XRF system that uses a tube with medical or industrial radiography systems. This is because of the relative newness of portable tube-based systems. In all likelihood, Innov-X personnel have experience providing the necessary documentation to the state in question, and can readily assist the customer in this process.

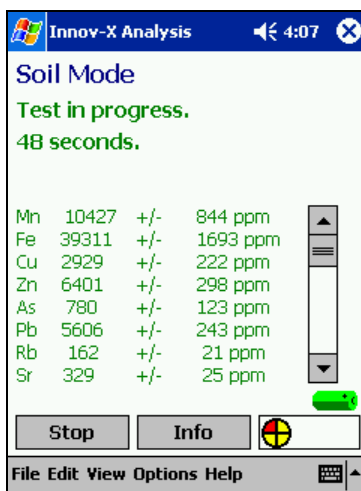
5.0S Soil Analysis

5.0 TESTING IN SOIL MODE

After the instrument has been standardized, testing can begin. Simply pull the trigger or press **Start** on the iPAQ screen to begin the test. The red warning light on the top of the instrument will blink, indicating X-rays are being emitted. The screen will display the words “Test in progress” and the time elapsed. The word “Testing” will blink on and off in the low right hand corner of the screen.

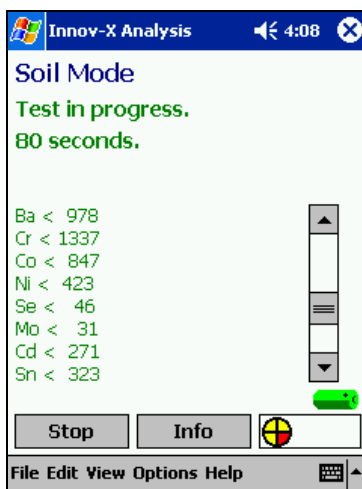


After a minimum time has elapsed, intermediate results will be displayed on the screen. This minimum time can be set by the user by selecting **Options** → **Setup Testing**. More details about this function can be found in the section **Soil Mode Options**. Each line of the results display shows the name of an element, its calculated concentration and the error on the measurement. This error is defined to be sigma, the error on the counting statistics of the measurement. The error will decrease with increased testing time.



Too many elements are measured in soil mode to display them at one time. As a result, it is possible to use the scroll bar located to the right of the chemistry display to view other elements. The complete display

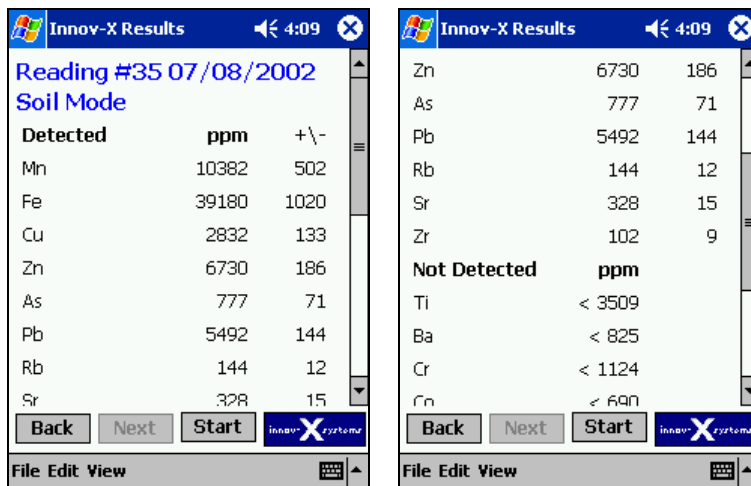
shows detected elements first, listed in order of atomic number, from lightest to heaviest. Following the detected elements are the elements which are below the detection limit of the instrument. These elements are shown as less than a calculated LOD. This LOD is defined as three times the error on the counting statistics of the measurement.



When the measurement is complete, the results screen will open displaying the final results of the measurement.

5.1 SOIL RESULTS SCREEN

The standard Soil Mode results screen displays the concentration in ppm and error in measurement for detected elements, followed by the list of non-detected elements with the calculated limit of detection for each element for the test. If the display does not show soil chemistry results, change the display by selecting either *View* → *Results* or *View* → *Chemistry*.

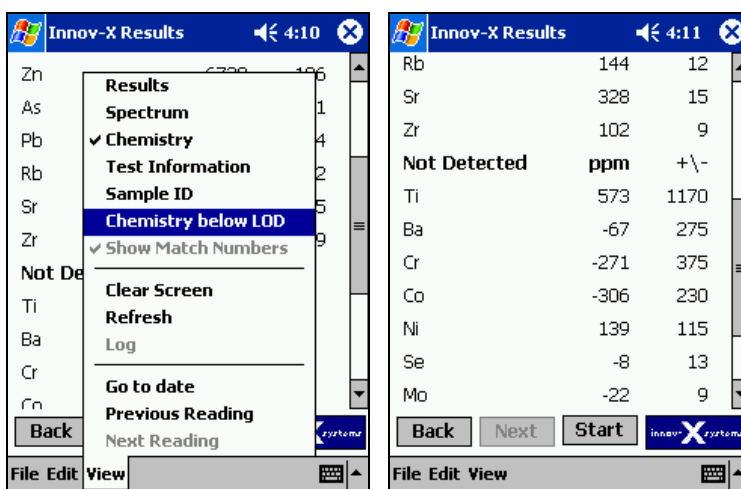


5.1.1 Results View Menu

The standard soil chemistry display can be modified by using the View Menu. As with all Innov-X software, it is possible to view spectra and Test Information. In addition, it is possible to view calculated chemistry below LOD.

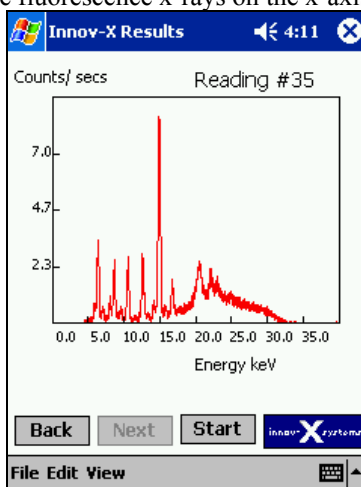
5.1.2 Chemistry Below LOD

A few select users have requested the ability to be able to see what the calculated chemistry would be for elements below detection limit. This can be done by selecting **View** → **Chemistry below LOD**. When this is done, the Elements below LOD are shown as a value in ppm, with an error. This is mainly for statistical purposes. These data should not be considered to be valid calculations. As a result, it is recommended that most users do not use this option.

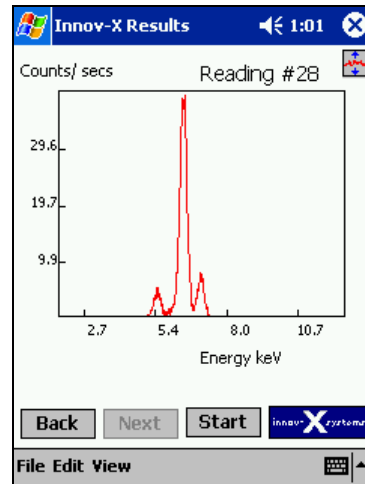
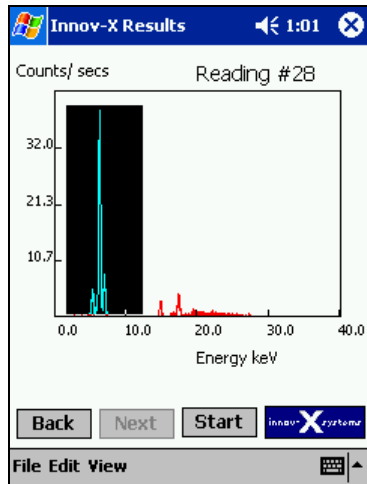


5.1.3 Spectrum Screen

This screen displays a plot of the x-ray fluorescence spectrum for an individual test, plotting the intensity on the y-axis versus the energy of the fluorescence x-rays on the x-axis.



Tapping on the spectra will show the energy scale and counts rate at the selected point. It is possible to zoom in on certain areas of the graph by selecting one corner and drawing out the out the region



Tapping the symbol in the upper right hand corner beneath the X will restore the graph to full scale.

5.1.4 Test Info Screen

The test information screen shows any information that was entered in TEST INFORMATION before starting a test.

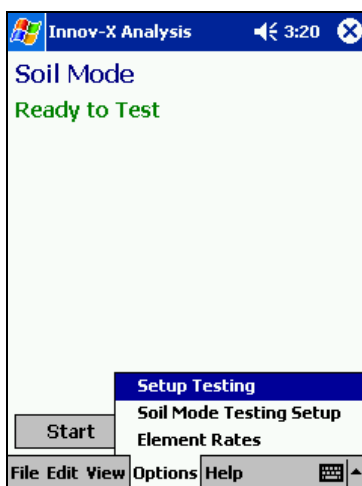
5.2 SOIL MODE OPTIONS

The length of tests in Soil Mode is user settable. Users may select a minimum testing time, and as well as choose from a variety of test end conditions.

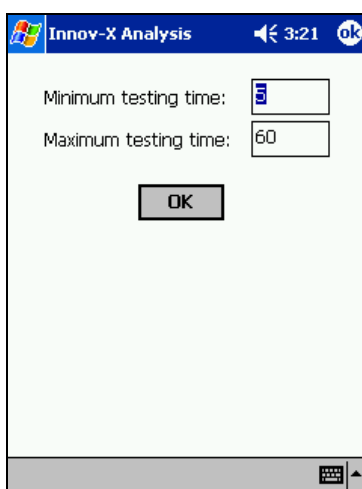
The options related to test time are contained in two menus: *Options* → *Setup Testing*, and *Options* → *Soil Mode Setup Testing*. *Setup Testing* contains minimum and maximum testing time information, while *Soil Mode Setup Testing* allows the user to select test end conditions.

5.2.1 Setup Testing Option—setting minimum and maximum testing times

To access the Setup Testing screen, select **Options** → **Setup Testing**



A screen appears prompting you to enter a Minimum and Maximum Testing time.



The minimum testing time is the required time that must elapse before results can be calculated. Live Update results will not be displayed on the screen until the minimum has elapsed, likewise a test must complete the minimum time before any test end condition can be used. If a test is stopped before the minimum testing time has elapsed, the test will be aborted, and no results will be calculated.

Maximum testing time is relevant only if “Maximum Testing Time” is selected from Soil Mode Setup Testing. This will automatically end the test at a preset testing time. Typically, the maximum testing time will be in excess of 30 seconds, and may be 1 or 2 minutes, depending on detection limits and desired precision.

It should be noted, that all testing times refer to “Real Time,” the time the measurement takes when timed on a normal clock. There is some detector dead time associated with a measurement so the length of the test stored in the analyzer may be slightly shorter than the preset time.

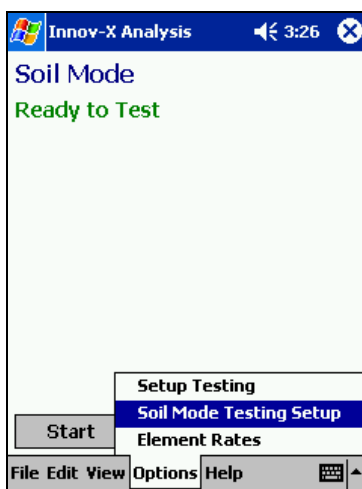
5.2.2 Soil Mode Testing Setup Option—Setting test end criteria

Four options exist for the test end criteria in soil mode. Depending on your application, you may choose to end the test manually, at a preset testing time, or when the uncertainty in the measurement is within a

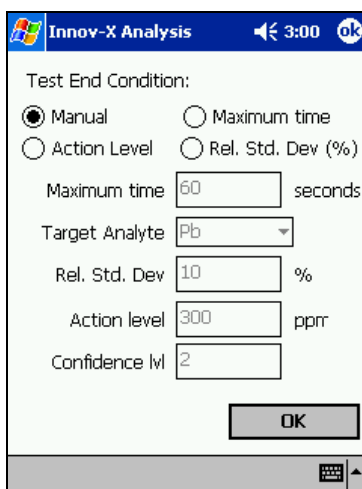
specified relative standard deviation of the reading. Additionally, you can set up an action level for a single element. As soon as the measuring statistics are good enough to ensure that the reading is above, below or at the action level, the test will end automatically. This allows for very rapid tests for elements that are well above or below an action level.

In all modes, pressing Stop, or pulling the trigger will end the test. If the minimum testing time has elapsed, results will be calculated. Otherwise the test will be aborted without calculating results.

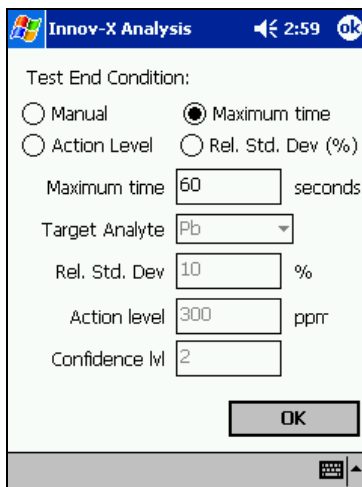
Manual: This option allows you to look at the results which are being continually updated on the screen and determine when the results look satisfactory. The test will continue until the trigger is pulled, or **Stop** is tapped on the iPAQ screen. Results will be calculated if the testing time has exceeded the Minimum Test time which is set up in **Options** → **Soil Mode Testing Setup**. In order to preserve battery life, the software will stop if the testing time exceeds 300 seconds, since there is little to no advantage to continuing a test beyond 300 seconds.



To use Manual Test End Condition, simply choose **Options** → **Soil Mode Testing Setup** and select **Manual**. Press **ok** to return to the analysis screen.



Maximum Time: If Maximum Time is selected, the test will continue until the preset Time is reached. This is useful if you wish to do a set of measurements with the same testing time.



Innov-X Analysis 2:59

Test End Condition:

☐ Manual ☒ Maximum time

☐ Action Level ☐ Rel. Std. Dev (%)

Maximum time 60 seconds

Target Analyte Pb

Rel. Std. Dev 10 %

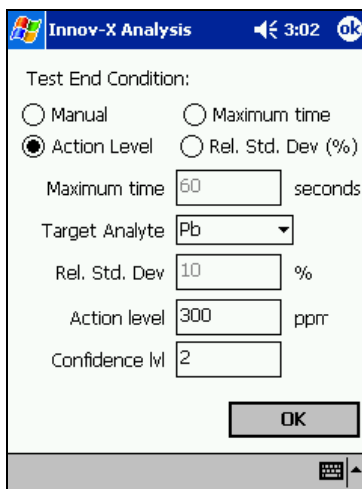
Action level 300 ppm

Confidence lvl 2

OK

To choose to end test based on a maximum time, select **Options** → **Soil Mode Testing Setup** and tap “Manual”. Enter the desired testing time in the appropriate test box. Tap ok to save your selections.

Action Level: System ends test when result for target analyte including chosen precision level is above or below pre-set action level.



Innov-X Analysis 3:02

Test End Condition:

☐ Manual ☐ Maximum time

☒ Action Level ☐ Rel. Std. Dev (%)

Maximum time 60 seconds

Target Analyte Pb

Rel. Std. Dev 10 %

Action level 300 ppm

Confidence lvl 2

OK

To choose to end a test based on an Action Level, select **Options** → **Soil Mode Testing Setup** and tap “Action Level.” Select a target analyte, specify an action level in ppm, and a confidence level. This confidence level refers to the number of sigma required for the precision. This should typically be set to 2. Tap ok to save your selections.

Relative Standard Deviation (RSD): When RSD is selected as a test end criterion; the system will end a test when the relative standard deviation on a target analyte reaches a pre-set level. This standard deviation is specified as a percentage of the reading. For example, if the measured value for an analyte was 1000 ppm, and the RSD was set to 10, the reading would stop when the error reached 100 ppm, or 10% of 1000.

Innov-X Analysis 3:02 ok

Test End Condition:

☐ Manual
 ☐ Maximum time
 ☐ Action Level
 ☒ Rel. Std. Dev (%)

Maximum time seconds

Target Analyte

Rel. Std. Dev %

Action level ppm

Confidence lvl

OK

To choose to end a test based on a Relative Standard Deviation, select **Options** → **Soil Mode Testing Setup** and tap “Rel. Std. Dev (%)”. Select a target analyte and the desired Relative Standard Deviation. Tap ok to save your selections.

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique which a laboratory can use as a basic starting point for generating its own detailed Standard Operating Procedure (SOP), either for its own general use or for a specific project application. The performance data included in this method are for guidance purposes only, and are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the in situ and intrusive analysis of the 26 analytes listed below for soil and sediment samples. Some common elements are not listed in this method because they are considered "light" elements that cannot be detected by field portable x-ray fluorescence (FPXRF). These light elements are: lithium, beryllium, sodium, magnesium, aluminum, silicon, and phosphorus. Most of the analytes listed below are of environmental concern, while a few others have interference effects or change the elemental composition of the matrix, affecting quantitation of the analytes of interest. Generally elements of atomic number 16 or greater can be detected and quantitated by FPXRF. The following RCRA analytes have been determined by this method:

Analytes	CAS Registry No.
Antimony (Sb)	7440-36-0
Arsenic (As)	7440-38-0
Barium (Ba)	7440-39-3
Cadmium (Cd)	7440-43-9
Chromium (Cr)	7440-47-3
Cobalt (Co)	7440-48-4
Copper (Cu)	7440-50-8
Lead (Pb)	7439-92-1
Mercury (Hg)	7439-97-6
Nickel (Ni)	7440-02-0
Selenium (Se)	7782-49-2
Silver (Ag)	7440-22-4
Thallium (Tl)	7440-28-0
Tin (Sn)	7440-31-5

Analytes	CAS Registry No.
Vanadium (V)	7440-62-2
Zinc (Zn)	7440-66-6

In addition, the following non-RCRA analytes have been determined by this method:

Analytes	CAS Registry No.
Calcium (Ca)	7440-70-2
Iron (Fe)	7439-89-6
Manganese (Mn)	7439-96-5
Molybdenum (Mo)	7439-93-7
Potassium (K)	7440-09-7
Rubidium (Rb)	7440-17-7
Strontium (Sr)	7440-24-6
Thorium (Th)	7440-29-1
Titanium (Ti)	7440-32-6
Zirconium (Zr)	7440-67-7

1.2 This method is a screening method to be used with confirmatory analysis using other techniques (e.g., flame atomic absorption spectrometry (FLAA), graphite furnace atomic absorption spectrometry (GFAA), inductively coupled plasma-atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)). This method's main strength is that it is a rapid field screening procedure. The method's lower limits of detection are typically above the toxicity characteristic regulatory level for most RCRA analytes. However, when the obtainable values for precision, accuracy, and laboratory-established sensitivity of this method meet project-specific data quality objectives (DQOs), FPXRF is a fast, powerful, cost effective technology for site characterization.

1.3 The method sensitivity or lower limit of detection depends on several factors, including the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement spectral interferences. Example lower limits of detection for analytes of interest in environmental applications are shown in Table 1. These limits apply to a clean spiked matrix of quartz sand (silicon dioxide) free of interelement spectral interferences using long (100 -600 second) count times. These sensitivity values are given for guidance only and may not always be achievable, since they will vary depending on the sample matrix, which instrument is used, and operating conditions. A discussion of performance-based sensitivity is presented in Sec. 9.6.

1.4 Analysts should consult the disclaimer statement at the front of the manual and the information in Chapter Two for guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies, and on the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytes of interest, in the matrix of interest, and at the levels of concern.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by EPA as guidance to be used by the analyst and the regulated community in making judgments necessary to generate results that meet the data quality objectives for the intended application.

1.5 Use of this method is restricted to use by, or under supervision of, personnel appropriately experienced and trained in the use and operation of an XRF instrument. Each analyst must demonstrate the ability to generate acceptable results with this method.

2.0 SUMMARY OF METHOD

2.1 The FPXRF technologies described in this method use either sealed radioisotope sources or x-ray tubes to irradiate samples with x-rays. When a sample is irradiated with x-rays, the source x-rays may undergo either scattering or absorption by sample atoms. This latter process is known as the photoelectric effect. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. Electrons in outer shells have higher energy states than inner shell electrons, and the outer shell electrons give off energy as they cascade down into the inner shell vacancies. This rearrangement of electrons results in emission of x-rays characteristic of the given atom. The emission of x-rays, in this manner, is termed x-ray fluorescence.

Three electron shells are generally involved in emission of x-rays during FPXRF analysis of environmental samples. The three electron shells include the K, L, and M shells. A typical emission pattern, also called an emission spectrum, for a given metal has multiple intensity peaks generated from the emission of K, L, or M shell electrons. The most commonly measured x-ray emissions are from the K and L shells; only metals with an atomic number greater than 57 have measurable M shell emissions.

Each characteristic x-ray line is defined with the letter K, L, or M, which signifies which shell had the original vacancy and by a subscript alpha (α), beta (β), or gamma (γ) etc., which indicates the higher shell from which electrons fell to fill the vacancy and produce the x-ray. For example, a K_α line is produced by a vacancy in the K shell filled by an L shell electron, whereas a K_β line is produced by a vacancy in the K shell filled by an M shell electron. The K_α transition is on average 6 to 7 times more probable than the K_β transition; therefore, the K_α line is approximately 7 times more intense than the K_β line for a given element, making the K_α line the choice for quantitation purposes.

The K lines for a given element are the most energetic lines and are the preferred lines for analysis. For a given atom, the x-rays emitted from L transitions are always less energetic than those emitted from K transitions. Unlike the K lines, the main L emission lines (L_α and L_β) for an element are of nearly equal intensity. The choice of one or the other depends on what interfering element lines might be present. The L emission lines are useful for analyses involving elements of atomic number (Z) 58 (cerium) through 92 (uranium).

An x-ray source can excite characteristic x-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element, that is, the K absorption edge, L absorption edge, or M absorption edge energy. The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies of the particular element, and the L absorption edge energy is approximately the sum of the L and M line energies. FPXRF is more sensitive to an element with an absorption edge energy close to but less than

the excitation energy of the source. For example, when using a cadmium-109 source, which has an excitation energy of 22.1 kiloelectron volts (keV), FPXRF would exhibit better sensitivity for zirconium which has a K line energy of 15.77 keV than to chromium, which has a K line energy of 5.41 keV.

2.2 Under this method, inorganic analytes of interest are identified and quantitated using a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an electrically excited x-ray tube is used to generate characteristic x-ray emissions from elements in a sample. Up to three sources may be used to irradiate a sample. Each source emits a specific set of primary x-rays that excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the source is selected according to its excitation efficiency for the element of interest.

For measurement, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments, specifically, in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis.

Sample analysis is then initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and are converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter. Within the detector, energies of the characteristic x-rays are converted into a train of electric pulses, the amplitudes of which are linearly proportional to the energy of the x-rays. An electronic multichannel analyzer (MCA) measures the pulse amplitudes, which is the basis of qualitative x-ray analysis. The number of counts at a given energy per unit of time is representative of the element concentration in a sample and is the basis for quantitative analysis. Most FPXRF instruments are menu-driven from software built into the units or from personal computers (PC).

The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurement times (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

FPXRF instruments can be calibrated using the following methods: internally using fundamental parameters determined by the manufacturer, empirically based on site-specific calibration standards (SSCS), or based on Compton peak ratios. The Compton peak is produced by backscattering of the source radiation. Some FPXRF instruments can be calibrated using multiple methods.

3.0 DEFINITIONS

3.1 FPXRF -- Field portable x-ray fluorescence.

3.2 MCA -- Multichannel analyzer for measuring pulse amplitude.

3.3 SSCS -- Site-specific calibration standards.

3.4 FP -- Fundamental parameter.

3.5 ROI -- Region of interest.

3.6 SRM -- Standard reference material; a standard containing certified amounts of metals in soil or sediment.

3.7 eV -- Electron volt; a unit of energy equivalent to the amount of energy gained by an electron passing through a potential difference of one volt.

3.8 Refer to Chapter One, Chapter Three, and the manufacturer's instructions for other definitions that may be relevant to this procedure.

4.0 INTERFERENCES

4.1 The total method error for FPXRF analysis is defined as the square root of the sum of squares of both instrument precision and user- or application-related error. Generally, instrument precision is the least significant source of error in FPXRF analysis. User- or application-related error is generally more significant and varies with each site and method used. Some sources of interference can be minimized or controlled by the instrument operator, but others cannot. Common sources of user- or application-related error are discussed below.

4.2 Physical matrix effects result from variations in the physical character of the sample. These variations may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, if any analyte exists in the form of very fine particles in a coarser-grained matrix, the analyte's concentration measured by the FPXRF will vary depending on how fine particles are distributed within the coarser-grained matrix. If the fine particles "settle" to the bottom of the sample cup (i.e., against the cup window), the analyte concentration measurement will be higher than if the fine particles are not mixed in well and stay on top of the coarser-grained particles in the sample cup. One way to reduce such error is to grind and sieve all soil samples to a uniform particle size thus reducing sample-to-sample particle size variability. Homogeneity is always a concern when dealing with soil samples. Every effort should be made to thoroughly mix and homogenize soil samples before analysis. Field studies have shown heterogeneity of the sample generally has the largest impact on comparability with confirmatory samples.

4.3 Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediment that are saturated with water. This error can be minimized by drying the samples in a convection or toaster oven. Microwave drying is not recommended because field studies have shown that microwave drying can increase variability between FPXRF data and confirmatory analysis and because metal fragments in the sample can cause arcing to occur in a microwave.

4.4 Inconsistent positioning of samples in front of the probe window is a potential source of error because the x-ray signal decreases as the distance from the radioactive source increases. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface.

4.5 Chemical matrix effects result from differences in the concentrations of interfering elements. These effects occur as either spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Both effects are common in soils contaminated with heavy metals. As examples of absorption and enhancement effects; iron (Fe) tends to absorb copper (Cu) x-rays, reducing the intensity of the Cu measured by the detector, while chromium (Cr) will be enhanced at the expense of Fe because the absorption edge of Cr is slightly lower in energy than the fluorescent peak of iron. The effects can be corrected mathematically through the use of fundamental parameter (FP) coefficients. The effects also can be compensated for using SSCS, which contain all the elements present on site that can interfere with one another.

4.6 When present in a sample, certain x-ray lines from different elements can be very close in energy and, therefore, can cause interference by producing a severely overlapped spectrum. The degree to which a detector can resolve the two different peaks depends on the energy resolution of the detector. If the energy difference between the two peaks in electron volts is less than the resolution of the detector in electron volts, then the detector will not be able to fully resolve the peaks.

The most common spectrum overlaps involve the K_{β} line of element Z-1 with the K_{α} line of element Z. This is called the K_{α}/K_{β} interference. Because the $K_{\alpha}:K_{\beta}$ intensity ratio for a given element usually is about 7:1, the interfering element, Z-1, must be present at large concentrations to cause a problem. Two examples of this type of spectral interference involve the presence of large concentrations of vanadium (V) when attempting to measure Cr or the presence of large concentrations of Fe when attempting to measure cobalt (Co). The V K_{α} and K_{β} energies are 4.95 and 5.43 keV, respectively, and the Cr K_{α} energy is 5.41 keV. The Fe K_{α} and K_{β} energies are 6.40 and 7.06 keV, respectively, and the Co K_{α} energy is 6.92 keV. The difference between the V K_{β} and Cr K_{α} energies is 20 eV, and the difference between the Fe K_{β} and the Co K_{α} energies is 140 eV. The resolution of the highest-resolution detectors in FPXRF instruments is 170 eV. Therefore, large amounts of V and Fe will interfere with quantitation of Cr or Co, respectively. The presence of Fe is a frequent problem because it is often found in soils at tens of thousands of parts per million (ppm).

4.7 Other interferences can arise from K/L, K/M, and L/M line overlaps, although these overlaps are less common. Examples of such overlap involve arsenic (As) K_{α} /lead (Pb) L_{α} and sulfur (S) K_{α} /Pb M_{α} . In the As/Pb case, Pb can be measured from the Pb L_{β} line, and As can be measured from either the As K_{α} or the As K_{β} line; in this way the interference can be corrected. If the As K_{β} line is used, sensitivity will be decreased by a factor of two to five times because it is a less intense line than the As K_{α} line. If the As K_{α} line is used in the presence of Pb, mathematical corrections within the instrument software can be used to subtract out the Pb interference. However, because of the limits of mathematical corrections, As concentrations cannot be efficiently calculated for samples with Pb:As ratios of 10:1 or more. This high ratio of Pb to As may result in reporting of a "nondetect" or a "less than" value (e.g., <300 ppm) for As, regardless of the actual concentration present.

No instrument can fully compensate for this interference. It is important for an operator to understand this limitation of FPXRF instruments and consult with the manufacturer of the FPXRF instrument to evaluate options to minimize this limitation. The operator's decision will be based on action levels for metals in soil established for the site, matrix effects, capabilities of the instrument, data quality objectives, and the ratio of lead to arsenic known to be present at the site. If a site is encountered that contains lead at concentrations greater than ten times the concentration of arsenic it is advisable that all critical soil samples be sent off site for confirmatory analysis using other techniques (e.g., flame atomic absorption spectrometry (FLAA), graphite furnace atomic absorption spectrometry (GFAA), inductively coupled plasma-

atomic emission spectrometry, (ICP-AES), or inductively coupled plasma-mass spectrometry, (ICP-MS)).

4.8 If SSCS are used to calibrate an FPXRF instrument, the samples collected must be representative of the site under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentrations of the contaminants of concern at a given time and location. Analytical results for representative samples reflect variations in the presence and concentration ranges of contaminants throughout a site. Variables affecting sample representativeness include differences in soil type, contaminant concentration variability, sample collection and preparation variability, and analytical variability, all of which should be minimized as much as possible.

4.9 Soil physical and chemical effects may be corrected using SSCS that have been analyzed by inductively coupled plasma (ICP) or atomic absorption (AA) methods. However, a major source of error can be introduced if these samples are not representative of the site or if the analytical error is large. Another concern is the type of digestion procedure used to prepare the soil samples for the reference analysis. Analytical results for the confirmatory method will vary depending on whether a partial digestion procedure, such as Method 3050, or a total digestion procedure, such as Method 3052, is used. It is known that depending on the nature of the soil or sediment, Method 3050 will achieve differing extraction efficiencies for different analytes of interest. The confirmatory method should meet the project-specific data quality objectives (DQOs).

XRF measures the total concentration of an element; therefore, to achieve the greatest comparability of this method with the reference method (reduced bias), a total digestion procedure should be used for sample preparation. However, in the study used to generate the performance data for this method (see Table 8), the confirmatory method used was Method 3050, and the FPXRF data compared very well with regression correlation coefficients (r often exceeding 0.95, except for barium and chromium). The critical factor is that the digestion procedure and analytical reference method used should meet the DQOs of the project and match the method used for confirmation analysis.

4.10 Ambient temperature changes can affect the gain of the amplifiers producing instrument drift. Gain or drift is primarily a function of the electronics (amplifier or preamplifier) and not the detector as most instrument detectors are cooled to a constant temperature. Most FPXRF instruments have a built-in automatic gain control. If the automatic gain control is allowed to make periodic adjustments, the instrument will compensate for the influence of temperature changes on its energy scale. If the FPXRF instrument has an automatic gain control function, the operator will not have to adjust the instrument's gain unless an error message appears. If an error message appears, the operator should follow the manufacturer's procedures for troubleshooting the problem. Often, this involves performing a new energy calibration. The performance of an energy calibration check to assess drift is a quality control measure discussed in Sec. 9.2.

If the operator is instructed by the manufacturer to manually conduct a gain check because of increasing or decreasing ambient temperature, it is standard to perform a gain check after every 10 to 20 sample measurements or once an hour whichever is more frequent. It is also suggested that a gain check be performed if the temperature fluctuates more than 10° F. The operator should follow the manufacturer's recommendations for gain check frequency.

5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The user is responsible for maintaining a safe work environment and a current awareness file of OSHA regulations regarding the safe handling of the chemicals listed in this method. A reference file of material safety data sheets (MSDSs) should be available to all personnel involved in these analyses.

NOTE: No MSDS applies directly to the radiation-producing instrument because that is covered under the Nuclear Regulatory Commission (NRC) or applicable state regulations.

5.2 Proper training for the safe operation of the instrument and radiation training should be completed by the analyst prior to analysis. Radiation safety for each specific instrument can be found in the operator's manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required. There should be a person appointed within the organization that is solely responsible for properly instructing all personnel, maintaining inspection records, and monitoring x-ray equipment at regular intervals.

Licenses for radioactive materials are of two types, specifically: (1) a general license which is usually initiated by the manufacturer for receiving, acquiring, owning, possessing, using, and transferring radioactive material incorporated in a device or equipment, and (2) a specific license which is issued to named persons for the operation of radioactive instruments as required by local, state, or federal agencies. A copy of the radioactive material license (for specific licenses only) and leak tests should be present with the instrument at all times and available to local and national authorities upon request.

X-ray tubes do not require radioactive material licenses or leak tests, but do require approvals and licenses which vary from state to state. In addition, fail-safe x-ray warning lights should be illuminated whenever an x-ray tube is energized. Provisions listed above concerning radiation safety regulations, shielding, training, and responsible personnel apply to x-ray tubes just as to radioactive sources. In addition, a log of the times and operating conditions should be kept whenever an x-ray tube is energized. An additional hazard present with x-ray tubes is the danger of electric shock from the high voltage supply, however, if the tube is properly positioned within the instrument, this is only a negligible risk. Any instrument (x-ray tube or radioisotope based) is capable of delivering an electric shock from the basic circuitry when the system is inappropriately opened.

5.3 Radiation monitoring equipment should be used with the handling and operation of the instrument. The operator and the surrounding environment should be monitored continually for analyst exposure to radiation. Thermal luminescent detectors (TLD) in the form of badges and rings are used to monitor operator radiation exposure. The TLDs or badges should be worn in the area of maximum exposure. The maximum permissible whole-body dose from occupational exposure is 5 Roentgen Equivalent Man (REM) per year. Possible exposure pathways for radiation to enter the body are ingestion, inhaling, and absorption. The best precaution to prevent radiation exposure is distance and shielding.

6.0 EQUIPMENT AND SUPPLIES

The mention of trade names or commercial products in this manual is for illustrative purposes only, and does not constitute an EPA endorsement or exclusive recommendation for

use. The products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency. Glassware, reagents, supplies, equipment, and settings other than those listed in this manual may be employed provided that method performance appropriate for the intended application has been demonstrated and documented.

6.1 FPXRF spectrometer -- An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer, such as an MCA, that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system. These components and additional, optional items, are discussed below.

6.1.1 Excitation sources -- FPXRF instruments use either a sealed radioisotope source or an x-ray tube to provide the excitation source. Many FPXRF instruments use sealed radioisotope sources to produce x-rays in order to irradiate samples. The FPXRF instrument may contain between one and three radioisotope sources. Common radioisotope sources used for analysis for metals in soils are iron Fe-55 (^{55}Fe), cadmium Cd-109 (^{109}Cd), americium Am-241 (^{241}Am), and curium Cm-244 (^{244}Cm). These sources may be contained in a probe along with a window and the detector; the probe may be connected to a data reduction and handling system by means of a flexible cable. Alternatively, the sources, window, and detector may be included in the same unit as the data reduction and handling system.

The relative strength of the radioisotope sources is measured in units of millicuries (mCi). All other components of the FPXRF system being equal, the stronger the source, the greater the sensitivity and precision of a given instrument. Radioisotope sources undergo constant decay. In fact, it is this decay process that emits the primary x-rays used to excite samples for FPXRF analysis. The decay of radioisotopes is measured in "half-lives." The half-life of a radioisotope is defined as the length of time required to reduce the radioisotopes strength or activity by half. Developers of FPXRF technologies recommend source replacement at regular intervals based on the source's half-life. This is due to the ever increasing time required for the analysis rather than a decrease in instrument performance. The characteristic x-rays emitted from each of the different sources have energies capable of exciting a certain range of analytes in a sample. Table 2 summarizes the characteristics of four common radioisotope sources.

X-ray tubes have higher radiation output, no intrinsic lifetime limit, produce constant output over their lifetime, and do not have the disposal problems of radioactive sources but are just now appearing in FPXRF instruments. An electrically-excited x-ray tube operates by bombarding an anode with electrons accelerated by a high voltage. The electrons gain an energy in electron volts equal to the accelerating voltage and can excite atomic transitions in the anode, which then produces characteristic x-rays. These characteristic x-rays are emitted through a window which contains the vacuum necessary for the electron acceleration. An important difference between x-ray tubes and radioactive sources is that the electrons which bombard the anode also produce a continuum of x-rays across a broad range of energies in addition to the characteristic x-rays. This continuum is weak compared to the characteristic x-rays but can provide substantial excitation since it covers a broad energy range. It has the undesired property of producing background in the spectrum near the analyte x-ray lines when it is scattered by the sample. For this reason a filter is often used between the x-ray tube and the sample to suppress the continuum radiation while passing the characteristic x-rays from the anode. This filter is sometimes incorporated into the window of the x-ray tube. The choice of

accelerating voltage is governed both by the anode material, since the electrons must have sufficient energy to excite the anode, which requires a voltage greater than the absorption edge of the anode material and by the instrument's ability to cool the x-ray tube. The anode is most efficiently excited by voltages 2 to 2.5 times the edge energy (most x-rays per unit power to the tube), although voltages as low as 1.5 times the absorption edge energy will work. The characteristic x-rays emitted by the anode are capable of exciting a range of elements in the sample just as with a radioactive source. Table 3 gives the recommended operating voltages and the sample elements excited for some common anodes.

6.1.2 Sample presentation device -- FPXRF instruments can be operated in two modes: in situ and intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. For FPXRF instruments operated in the intrusive mode, the probe may be rotated so that the window faces either upward or downward. A protective sample cover is placed over the window, and the sample cup is placed on top of the window inside the protective sample cover for analysis.

6.1.3 Detectors -- The detectors in the FPXRF instruments can be either solid-state detectors or gas-filled, proportional counter detectors. Common solid-state detectors include mercuric iodide (HgI_2), silicon pin diode and lithium-drifted silicon $\text{Si}(\text{Li})$. The HgI_2 detector is operated at a moderately subambient temperature controlled by a low power thermoelectric cooler. The silicon pin diode detector also is cooled via the thermoelectric Peltier effect. The $\text{Si}(\text{Li})$ detector must be cooled to at least -90°C either with liquid nitrogen or by thermoelectric cooling via the Peltier effect. Instruments with a $\text{Si}(\text{Li})$ detector have an internal liquid nitrogen dewar with a capacity of 0.5 to 1.0 L. Proportional counter detectors are rugged and lightweight, which are important features of a field portable detector. However, the resolution of a proportional counter detector is not as good as that of a solid-state detector. The energy resolution of a detector for characteristic x-rays is usually expressed in terms of full width at half-maximum (FWHM) height of the manganese K_α peak at 5.89 keV. The typical resolutions of the above mentioned detectors are as follows: HgI_2 –270 eV; silicon pin diode–250 eV; $\text{Si}(\text{Li})$ –170 eV; and gas-filled, proportional counter–750 eV.

During operation of a solid-state detector, an x-ray photon strikes a biased, solid-state crystal and loses energy in the crystal by producing electron-hole pairs. The electric charge produced is collected and provides a current pulse that is directly proportional to the energy of the x-ray photon absorbed by the crystal of the detector. A gas-filled, proportional counter detector is an ionization chamber filled with a mixture of noble and other gases. An x-ray photon entering the chamber ionizes the gas atoms. The electric charge produced is collected and provides an electric signal that is directly proportional to the energy of the x-ray photon absorbed by the gas in the detector.

6.1.4 Data processing units -- The key component in the data processing unit of an FPXRF instrument is the MCA. The MCA receives pulses from the detector and sorts them by their amplitudes (energy level). The MCA counts pulses per second to determine the height of the peak in a spectrum, which is indicative of the target analyte's concentration. The spectrum of element peaks are built on the MCA. The MCAs in FPXRF instruments have from 256 to 2,048 channels. The concentrations of target analytes are usually shown in ppm on a liquid crystal display (LCD) in the instrument. FPXRF instruments can store both spectra and from 3,000 to 5,000 sets of numerical analytical results. Most FPXRF instruments are menu-driven from software built into the

units or from PCs. Once the data-storage memory of an FPXRF unit is full or at any other time, data can be downloaded by means of an RS-232 port and cable to a PC.

6.2 Spare battery and battery charger.

6.3 Polyethylene sample cups -- 31 to 40 mm in diameter with collar, or equivalent (appropriate for FPXRF instrument).

6.4 X-ray window film -- Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 µm thick.

6.5 Mortar and pestle -- Glass, agate, or aluminum oxide; for grinding soil and sediment samples.

6.6 Containers -- Glass or plastic to store samples.

6.7 Sieves -- 60-mesh (0.25 mm), stainless-steel, Nylon, or equivalent for preparing soil and sediment samples.

6.8 Trowels -- For smoothing soil surfaces and collecting soil samples.

6.9 Plastic bags -- Used for collection and homogenization of soil samples.

6.10 Drying oven -- Standard convection or toaster oven, for soil and sediment samples that require drying.

7.0 REAGENTS AND STANDARDS

7.1 Reagent grade chemicals must be used in all tests. Unless otherwise indicated, it is intended that all reagents conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available. Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

7.2 Pure element standards -- Each pure, single-element standard is intended to produce strong characteristic x-ray peaks of the element of interest only. Other elements present must not contribute to the fluorescence spectrum. A set of pure element standards for commonly sought analytes is supplied by the instrument manufacturer, if designated for the instrument; not all instruments require the pure element standards. The standards are used to set the region of interest (ROI) for each element. They also can be used as energy calibration and resolution check samples.

7.3 Site-specific calibration standards -- Instruments that employ fundamental parameters (FP) or similar mathematical models in minimizing matrix effects may not require SSCS. If the FP calibration model is to be optimized or if empirical calibration is necessary, then SSCSs must be collected, prepared, and analyzed.

7.3.1 The SSCS must be representative of the matrix to be analyzed by FPXRF. These samples must be well homogenized. A minimum of 10 samples spanning the concentration ranges of the analytes of interest and of the interfering elements must be obtained from the site. A sample size of 4 to 8 ounces is recommended, and standard glass sampling jars should be used.

7.3.2 Each sample should be oven-dried for 2 to 4 hr at a temperature of less than 150 °C. If mercury is to be analyzed, a separate sample portion should be dried at ambient temperature as heating may volatilize the mercury. When the sample is dry, all large, organic debris and nonrepresentative material, such as twigs, leaves, roots, insects, asphalt, and rock should be removed. The sample should be homogenized (see Sec. 7.3.3) and then a representative portion ground with a mortar and pestle or other mechanical means, prior to passing through a 60-mesh sieve. Only the coarse rock fraction should remain on the screen.

7.3.3 The sample should be homogenized by using a riffle splitter or by placing 150 to 200 g of the dried, sieved sample on a piece of kraft or butcher paper about 1.5 by 1.5 feet in size. Each corner of the paper should be lifted alternately, rolling the soil over on itself and toward the opposite corner. The soil should be rolled on itself 20 times. Approximately 5 g of the sample should then be removed and placed in a sample cup for FPXRF analysis. The rest of the prepared sample should be sent off site for ICP or AA analysis. The method use for confirmatory analysis should meet the data quality objectives of the project.

7.4 Blank samples -- The blank samples should be from a "clean" quartz or silicon dioxide matrix that is free of any analytes at concentrations above the established lower limit of detection. These samples are used to monitor for cross-contamination and laboratory-induced contaminants or interferences.

7.5 Standard reference materials -- Standard reference materials (SRMs) are standards containing certified amounts of metals in soil or sediment. These standards are used for accuracy and performance checks of FPXRF analyses. SRMs can be obtained from the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), the Canadian National Research Council, and the national bureau of standards in foreign nations. Pertinent NIST SRMs for FPXRF analysis include 2704, Buffalo River Sediment; 2709, San Joaquin Soil; and 2710 and 2711, Montana Soil. These SRMs contain soil or sediment from actual sites that has been analyzed using independent inorganic analytical methods by many different laboratories. When these SRMs are unavailable, alternate standards may be used (e.g., NIST 2702).

8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Sample handling and preservation procedures used in FPXRF analyses should follow the guidelines in Chapter Three, "Inorganic Analytes."

9.0 QUALITY CONTROL

9.1 Follow the manufacturer's instructions for the quality control procedures specific to use of the testing product. Refer to Chapter One for additional guidance on quality assurance (QA) and quality control (QC) protocols. Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those that will implement the project and assess the results.

9.2 Energy calibration check -- To determine whether an FPXRF instrument is operating within resolution and stability tolerances, an energy calibration check should be run. The energy calibration check determines whether the characteristic x-ray lines are shifting,

which would indicate drift within the instrument. As discussed in Sec. 4.10, this check also serves as a gain check in the event that ambient temperatures are fluctuating greatly (more than 10 °F).

9.2.1 The energy calibration check should be run at a frequency consistent with manufacturer's recommendations. Generally, this would be at the beginning of each working day, after the batteries are changed or the instrument is shut off, at the end of each working day, and at any other time when the instrument operator believes that drift is occurring during analysis. A pure element such as iron, manganese, copper, or lead is often used for the energy calibration check. A manufacturer-recommended count time per source should be used for the check.

9.2.2 The instrument manufacturer's manual specifies the channel or kiloelectron volt level at which a pure element peak should appear and the expected intensity of the peak. The intensity and channel number of the pure element as measured using the source should be checked and compared to the manufacturer's recommendation. If the energy calibration check does not meet the manufacturer's criteria, then the pure element sample should be repositioned and reanalyzed. If the criteria are still not met, then an energy calibration should be performed as described in the manufacturer's manual. With some FPXRF instruments, once a spectrum is acquired from the energy calibration check, the peak can be optimized and realigned to the manufacturer's specifications using their software.

9.3 Blank samples -- Two types of blank samples should be analyzed for FPXRF analysis, specifically, instrument blanks and method blanks.

9.3.1 An instrument blank is used to verify that no contamination exists in the spectrometer or on the probe window. The instrument blank can be silicon dioxide, a polytetrafluoroethylene (PTFE) block, a quartz block, "clean" sand, or lithium carbonate. This instrument blank should be analyzed on each working day before and after analyses are conducted and once per every twenty samples. An instrument blank should also be analyzed whenever contamination is suspected by the analyst. The frequency of analysis will vary with the data quality objectives of the project. A manufacturer-recommended count time per source should be used for the blank analysis. No element concentrations above the established lower limit of detection should be found in the instrument blank. If concentrations exceed these limits, then the probe window and the check sample should be checked for contamination. If contamination is not a problem, then the instrument must be "zeroed" by following the manufacturer's instructions.

9.3.2 A method blank is used to monitor for laboratory-induced contaminants or interferences. The method blank can be "clean" silica sand or lithium carbonate that undergoes the same preparation procedure as the samples. A method blank must be analyzed at least daily. The frequency of analysis will depend on the data quality objectives of the project. If the method blank does not contain the target analyte at a level that interferes with the project-specific data quality objectives then the method blank would be considered acceptable. In the absence of project-specific data quality objectives, if the blank is less than the lowest level of detection or less than 10% of the lowest sample concentration for the analyte, whichever is greater, then the method blank would be considered acceptable. If the method blank cannot be considered acceptable, the cause of the problem must be identified, and all samples analyzed with the method blank must be reanalyzed.

9.4 Calibration verification checks -- A calibration verification check sample is used to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest. A check sample should be analyzed at the beginning of each working day, during active sample analyses, and at the end of each working day. The frequency of calibration checks during active analysis will depend on the data quality objectives of the project. The check sample should be a well characterized soil sample from the site that is representative of site samples in terms of particle size and degree of homogeneity and that contains contaminants at concentrations near the action levels. If a site-specific sample is not available, then an NIST or other SRM that contains the analytes of interest can be used to verify the accuracy of the instrument. The measured value for each target analyte should be within ± 20 percent (%D) of the true value for the calibration verification check to be acceptable. If a measured value falls outside this range, then the check sample should be reanalyzed. If the value continues to fall outside the acceptance range, the instrument should be recalibrated, and the batch of samples analyzed before the unacceptable calibration verification check must be reanalyzed.

9.5 Precision measurements -- The precision of the method is monitored by analyzing a sample with low, moderate, or high concentrations of target analytes. The frequency of precision measurements will depend on the data quality objectives for the data. A minimum of one precision sample should be run per day. Each precision sample should be analyzed 7 times in replicate. It is recommended that precision measurements be obtained for samples with varying concentration ranges to assess the effect of concentration on method precision. Determining method precision for analytes at concentrations near the site action levels can be extremely important if the FPXRF results are to be used in an enforcement action; therefore, selection of at least one sample with target analyte concentrations at or near the site action levels or levels of concern is recommended. A precision sample is analyzed by the instrument for the same field analysis time as used for other project samples. The relative standard deviation (RSD) of the sample mean is used to assess method precision. For FPXRF data to be considered adequately precise, the RSD should not be greater than 20 percent with the exception of chromium. RSD values for chromium should not be greater than 30 percent. If both in situ and intrusive analytical techniques are used during the course of one day, it is recommended that separate precision calculations be performed for each analysis type.

The equation for calculating RSD is as follows:

$$\text{RSD} = (\text{SD}/\text{Mean Concentration}) \times 100$$

where:

RSD	=	Relative standard deviation for the precision measurement for the analyte
SD	=	Standard deviation of the concentration for the analyte
Mean concentration	=	Mean concentration for the analyte

The precision or reproducibility of a measurement will improve with increasing count time, however, increasing the count time by a factor of 4 will provide only 2 times better precision, so there is a point of diminishing return. Increasing the count time also improves the sensitivity, but decreases sample throughput.

9.6 The lower limits of detection should be established from actual measured performance based on spike recoveries in the matrix of concern or from acceptable method performance on a certified reference material of the appropriate matrix and within the appropriate calibration range for the application. This is considered the best estimate of the true method sensitivity as opposed to a statistical determination based on the standard deviation of

replicate analyses of a low-concentration sample. While the statistical approach demonstrates the potential data variability for a given sample matrix at one point in time, it does not represent what can be detected or most importantly the lowest concentration that can be calibrated. For this reason the sensitivity should be established as the lowest point of detection based on acceptable target analyte recovery in the desired sample matrix.

9.7 Confirmatory samples -- The comparability of the FPXRF analysis is determined by submitting FPXRF-analyzed samples for analysis at a laboratory. The method of confirmatory analysis must meet the project and XRF measurement data quality objectives. The confirmatory samples must be splits of the well homogenized sample material. In some cases the prepared sample cups can be submitted. A minimum of 1 sample for each 20 FPXRF-analyzed samples should be submitted for confirmatory analysis. This frequency will depend on project-specific data quality objectives. The confirmatory analyses can also be used to verify the quality of the FPXRF data. The confirmatory samples should be selected from the lower, middle, and upper range of concentrations measured by the FPXRF. They should also include samples with analyte concentrations at or near the site action levels. The results of the confirmatory analysis and FPXRF analyses should be evaluated with a least squares linear regression analysis. If the measured concentrations span more than one order of magnitude, the data should be log-transformed to standardize variance which is proportional to the magnitude of measurement. The correlation coefficient (r) for the results should be 0.7 or greater for the FPXRF data to be considered screening level data. If the r is 0.9 or greater and inferential statistics indicate the FPXRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Instrument calibration -- Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator's manual for each specific FPXRF instrument. Generally, however, three types of calibration procedures exist for FPXRF instruments, namely: FP calibration, empirical calibration, and the Compton peak ratio or normalization method. These three types of calibration are discussed below.

10.2 Fundamental parameters calibration -- FP calibration procedures are extremely variable. An FP calibration provides the analyst with a "standardless" calibration. The advantages of FP calibrations over empirical calibrations include the following:

- No previously collected site-specific samples are necessary, although site-specific samples with confirmed and validated analytical results for all elements present could be used.
- Cost is reduced because fewer confirmatory laboratory results or calibration standards are necessary.

However, the analyst should be aware of the limitations imposed on FP calibration by particle size and matrix effects. These limitations can be minimized by adhering to the preparation procedure described in Sec. 7.3. The two FP calibration processes discussed below are based on an effective energy FP routine and a back scatter with FP (BFP) routine. Each FPXRF FP calibration process is based on a different iterative algorithmic method. The calibration procedure for each routine is explained in detail in the manufacturer's user manual for each FPXRF instrument; in addition, training courses are offered for each instrument.

10.2.1 Effective energy FP calibration -- The effective energy FP calibration is performed by the manufacturer before an instrument is sent to the analyst. Although SSCS can be used, the calibration relies on pure element standards or SRMs such as those obtained from NIST for the FP calibration. The effective energy routine relies on the spectrometer response to pure elements and FP iterative algorithms to compensate for various matrix effects.

Alpha coefficients are calculated using a variation of the Sherman equation, which calculates theoretical intensities from the measurement of pure element samples. These coefficients indicate the quantitative effect of each matrix element on an analyte's measured x-ray intensity. Next, the Lachance Traill algorithm is solved as a set of simultaneous equations based on the theoretical intensities. The alpha coefficients are then downloaded into the specific instrument.

The working effective energy FP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of sampling. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. A manufacturer-recommended count time per source should be used for the calibration check. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A percent difference (%D) is then calculated for each target analyte. The %D should be within ± 20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line or the y-intercept value for the analyte. The SRM or SSCS is reanalyzed until the %D falls within ± 20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

The equation to calibrate %D is as follows:

$$\%D = ((C_s - C_k) / C_k) \times 100$$

where:

%D = Percent difference

C_k = Certified concentration of standard sample

C_s = Measured concentration of standard sample

10.2.2 BFP calibration -- BFP calibration relies on the ability of the liquid nitrogen-cooled, Si(Li) solid-state detector to separate the coherent (Compton) and incoherent (Rayleigh) backscatter peaks of primary radiation. These peak intensities are known to be a function of sample composition, and the ratio of the Compton to Rayleigh peak is a function of the mass absorption of the sample. The calibration procedure is explained in detail in the instrument manufacturer's manual. Following is a general description of the BFP calibration procedure.

The concentrations of all detected and quantified elements are entered into the computer software system. Certified element results for an NIST SRM or confirmed and validated results for an SSCS can be used. In addition, the concentrations of oxygen and silicon must be entered; these two concentrations are not found in standard metals analyses. The manufacturer provides silicon and oxygen concentrations for typical soil types. Pure element standards are then analyzed using a manufacturer-recommended

count time per source. The results are used to calculate correction factors in order to adjust for spectrum overlap of elements.

The working BFP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of the analysis. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. The standard sample is analyzed using a manufacturer-recommended count time per source to check the calibration curve. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A %D is then calculated for each target analyte. The %D should fall within ± 20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line the y-intercept value for the analyte. The standard sample is reanalyzed until the %D falls within ± 20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

10.3 Empirical calibration -- An empirical calibration can be performed with SSCS, site-typical standards, or standards prepared from metal oxides. A discussion of SSCS is included in Sec. 7.3; if no previously characterized samples exist for a specific site, site-typical standards can be used. Site-typical standards may be selected from commercially available characterized soils or from SSCS prepared for another site. The site-typical standards should closely approximate the site's soil matrix with respect to particle size distribution, mineralogy, and contaminant analytes. If neither SSCS nor site-typical standards are available, it is possible to make gravimetric standards by adding metal oxides to a "clean" sand or silicon dioxide matrix that simulates soil. Metal oxides can be purchased from various chemical vendors. If standards are made on site, a balance capable of weighing items to at least two decimal places is necessary. Concentrated ICP or AA standard solutions can also be used to make standards. These solutions are available in concentrations of 10,000 parts per million, thus only small volumes have to be added to the soil.

An empirical calibration using SSCS involves analysis of SSCS by the FPXRF instrument and by a conventional analytical method such as ICP or AA. A total acid digestion procedure should be used by the laboratory for sample preparation. Generally, a minimum of 10 and a maximum of 30 well characterized SSCS, site-typical standards, or prepared metal oxide standards are necessary to perform an adequate empirical calibration. The exact number of standards depends on the number of analytes of interest and interfering elements. Theoretically, an empirical calibration with SSCS should provide the most accurate data for a site because the calibration compensates for site-specific matrix effects.

The first step in an empirical calibration is to analyze the pure element standards for the elements of interest. This enables the instrument to set channel limits for each element for spectral deconvolution. Next the SSCS, site-typical standards, or prepared metal oxide standards are analyzed using a count time of 200 seconds per source or a count time recommended by the manufacturer. This will produce a spectrum and net intensity of each analyte in each standard. The analyte concentrations for each standard are then entered into the instrument software; these concentrations are those obtained from the laboratory, the certified results, or the gravimetrically determined concentrations of the prepared standards. This gives the instrument analyte values to regress against corresponding intensities during the modeling stage. The regression equation correlates the concentrations of an analyte with its net intensity.

The calibration equation is developed using a least squares fit regression analysis. After the regression terms to be used in the equation are defined, a mathematical equation can be developed to calculate the analyte concentration in an unknown sample. In some FPXRF instruments, the software of the instrument calculates the regression equation. The software uses calculated intercept and slope values to form a multiterm equation. In conjunction with the software in the instrument, the operator can adjust the multiterm equation to minimize interelement interferences and optimize the intensity calibration curve.

It is possible to define up to six linear or nonlinear terms in the regression equation. Terms can be added and deleted to optimize the equation. The goal is to produce an equation with the smallest regression error and the highest correlation coefficient. These values are automatically computed by the software as the regression terms are added, deleted, or modified. It is also possible to delete data points from the regression line if these points are significant outliers or if they are heavily weighing the data. Once the regression equation has been selected for an analyte, the equation can be entered into the software for quantitation of analytes in subsequent samples. For an empirical calibration to be acceptable, the regression equation for a specific analyte should have a correlation coefficient of 0.98 or greater or meet the DQOs of the project.

In an empirical calibration, one must apply the DQOs of the project and ascertain critical or action levels for the analytes of interest. It is within these concentration ranges or around these action levels that the FPXRF instrument should be calibrated most accurately. It may not be possible to develop a good regression equation over several orders of analyte concentration.

10.4 Compton normalization method -- The Compton normalization method is based on analysis of a single, certified standard and normalization for the Compton peak. The Compton peak is produced from incoherent backscattering of x-ray radiation from the excitation source and is present in the spectrum of every sample. The Compton peak intensity changes with differing matrices. Generally, matrices dominated by lighter elements produce a larger Compton peak, and those dominated by heavier elements produce a smaller Compton peak. Normalizing to the Compton peak can reduce problems with varying matrix effects among samples. Compton normalization is similar to the use of internal standards in organics analysis. The Compton normalization method may not be effective when analyte concentrations exceed a few percent.

The certified standard used for this type of calibration could be an NIST SRM such as 2710 or 2711. The SRM must be a matrix similar to the samples and must contain the analytes of interests at concentrations near those expected in the samples. First, a response factor has to be determined for each analyte. This factor is calculated by dividing the net peak intensity by the analyte concentration. The net peak intensity is gross intensity corrected for baseline reading. Concentrations of analytes in samples are then determined by multiplying the baseline corrected analyte signal intensity by the normalization factor and by the response factor. The normalization factor is the quotient of the baseline corrected Compton K_{α} peak intensity of the SRM divided by that of the samples. Depending on the FPXRF instrument used, these calculations may be done manually or by the instrument software.

11.0 PROCEDURE

11.1 Operation of the various FPXRF instruments will vary according to the manufacturers' protocols. Before operating any FPXRF instrument, one should consult the manufacturer's manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later during analysis.

11.2 Each FPXRF instrument should be operated according to the manufacturer's recommendations. There are two modes in which FPXRF instruments can be operated: in situ and intrusive. The in situ mode involves analysis of an undisturbed soil sediment or sample. Intrusive analysis involves collection and preparation of a soil or sediment sample before analysis. Some FPXRF instruments can operate in both modes of analysis, while others are designed to operate in only one mode. The two modes of analysis are discussed below.

11.3 For in situ analysis, remove any large or nonrepresentative debris from the soil surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots, and concrete. Also, the soil surface must be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel. During the study conducted to provide example performance data for this method, this modest amount of sample preparation was found to take less than 5 min per sample location. The last requirement is that the soil or sediment not be saturated with water. Manufacturers state that their FPXRF instruments will perform adequately for soils with moisture contents of 5 to 20 percent but will not perform well for saturated soils, especially if ponded water exists on the surface. Another recommended technique for in situ analysis is to tamp the soil to increase soil density and compactness for better repeatability and representativeness. This condition is especially important for heavy element analysis, such as barium. Source count times for in situ analysis usually range from 30 to 120 seconds, but source count times will vary among instruments and depending on the desired method sensitivity. Due to the heterogeneous nature of the soil sample, in situ analysis can provide only "screening" type data.

11.4 For intrusive analysis of surface or sediment, it is recommended that a sample be collected from a 4- by 4-inch square that is 1 inch deep. This will produce a soil sample of approximately 375 g or 250 cm³, which is enough soil to fill an 8-ounce jar. However, the exact dimensions and sample depth should take into consideration the heterogeneous deposition of contaminants and will ultimately depend on the desired project-specific data quality objectives. The sample should be homogenized, dried, and ground before analysis. The sample can be homogenized before or after drying. The homogenization technique to be used after drying is discussed in Sec. 4.2. If the sample is homogenized before drying, it should be thoroughly mixed in a beaker or similar container, or if the sample is moist and has a high clay content, it can be kneaded in a plastic bag. One way to monitor homogenization when the sample is kneaded in a plastic bag is to add sodium fluorescein dye to the sample. After the moist sample has been homogenized, it is examined under an ultraviolet light to assess the distribution of sodium fluorescein throughout the sample. If the fluorescent dye is evenly distributed in the sample, homogenization is considered complete; if the dye is not evenly distributed, mixing should continue until the sample has been thoroughly homogenized. During the study conducted to provide data for this method, the time necessary for homogenization procedure using the fluorescein dye ranged from 3 to 5 min per sample. As demonstrated in Secs. 13.5 and 13.7, homogenization has the greatest impact on the reduction of sampling variability. It produces little or no contamination. Often, the direct analysis through the plastic bag is possible without the more labor intensive steps of drying, grinding, and sieving given in Secs. 11.5 and 11.6. Of course, to achieve the best data quality possible all four steps should be followed.

11.5 Once the soil or sediment sample has been homogenized, it should be dried. This can be accomplished with a toaster oven or convection oven. A small aliquot of the sample (20 to 50 g) is placed in a suitable container for drying. The sample should be dried for 2 to 4 hr in the convection or toaster oven at a temperature not greater than 150 °C. Samples may also be air dried under ambient temperature conditions using a 10- to 20-g portion. Regardless of what drying mechanism is used, the drying process is considered complete when a constant sample weight can be obtained. Care should be taken to avoid sample cross-contamination and these measures can be evaluated by including an appropriate method blank sample along with any sample preparation process.

CAUTION: Microwave drying is not a recommended procedure. Field studies have shown that microwave drying can increase variability between the FPXRF data and confirmatory analysis. High levels of metals in a sample can cause arcing in the microwave oven, and sometimes slag forms in the sample. Microwave oven drying can also melt plastic containers used to hold the sample.

11.6 The homogenized dried sample material should be ground with a mortar and pestle and passed through a 60-mesh sieve to achieve a uniform particle size. Sample grinding should continue until at least 90 percent of the original sample passes through the sieve. The grinding step normally takes an average of 10 min per sample. An aliquot of the sieved sample should then be placed in a 31.0-mm polyethylene sample cup (or equivalent) for analysis. The sample cup should be one-half to three-quarters full at a minimum. The sample cup should be covered with a 2.5 μm Mylar (or equivalent) film for analysis. The rest of the soil sample should be placed in a jar, labeled, and archived for possible confirmation analysis. All equipment including the mortar, pestle, and sieves must be thoroughly cleaned so that any cross-contamination is below the established lower limit of detection of the procedure or DQOs of the analysis. If all recommended sample preparation steps are followed, there is a high probability the desired laboratory data quality may be obtained.

12.0 DATA ANALYSIS AND CALCULATIONS

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in ppm and can be downloaded to a personal computer, which can be used to provide a hard copy printout. Individual measurements that are smaller than three times their associated SD should not be used for quantitation. See the manufacturer's instructions regarding data analysis and calculations.

13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data do not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. These performance data are not intended to be and must not be used as absolute QC acceptance criteria for purposes of laboratory accreditation.

13.2 The sections to follow discuss three performance evaluation factors; namely, precision, accuracy, and comparability. The example data presented in Tables 4 through 8 were generated from results obtained from six FPXRF instruments (see Sec. 13.3). The soil samples analyzed by the six FPXRF instruments were collected from two sites in the United States. The soil samples contained several of the target analytes at concentrations ranging from "nondetect" to tens of thousands of mg/kg. These data are provided for guidance purposes only.

13.3 The six FPXRF instruments included the TN 9000 and TN Lead Analyzer manufactured by TN Spectrace; the X-MET 920 with a SiLi detector and X-MET 920 with a gas-filled proportional detector manufactured by Metorex, Inc.; the XL Spectrum Analyzer manufactured by Niton; and the MAP Spectrum Analyzer manufactured by Scitec. The TN 9000 and TN Lead Analyzer both have a HgI_2 detector. The TN 9000 utilized an Fe-55, Cd-109, and Am-241 source. The TN Lead Analyzer had only a Cd-109 source. The X-Met 920 with the SiLi detector had a Cd-109 and Am-241 source. The X-MET 920 with the gas-filled proportional detector had only a Cd-109 source. The XL Spectrum Analyzer utilized a silicon pin-diode

detector and a Cd-109 source. The MAP Spectrum Analyzer utilized a solid-state silicon detector and a Cd-109 source.

13.4 All example data presented in Tables 4 through 8 were generated using the following calibrations and source count times. The TN 9000 and TN Lead Analyzer were calibrated using fundamental parameters using NIST SRM 2710 as a calibration check sample. The TN 9000 was operated using 100, 60, and 60 second count times for the Cd-109, Fe-55, and Am-241 sources, respectively. The TN Lead analyzer was operated using a 60 second count time for the Cd-109 source. The X-MET 920 with the Si(Li) detector was calibrated using fundamental parameters and one well characterized site-specific soil standard as a calibration check. It used 140 and 100 second count times for the Cd-109 and Am-241 sources, respectively. The X-MET 920 with the gas-filled proportional detector was calibrated empirically using between 10 and 20 well characterized site-specific soil standards. It used 120 second times for the Cd-109 source. The XL Spectrum Analyzer utilized NIST SRM 2710 for calibration and the Compton peak normalization procedure for quantitation based on 60 second count times for the Cd-109 source. The MAP Spectrum Analyzer was internally calibrated by the manufacturer. The calibration was checked using a well-characterized site-specific soil standard. It used 240 second times for the Cd-109 source.

13.5 Precision measurements -- The example precision data are presented in Table 4. These data are provided for guidance purposes only. Each of the six FPXRF instruments performed 10 replicate measurements on 12 soil samples that had analyte concentrations ranging from "nondetects" to thousands of mg/kg. Each of the 12 soil samples underwent 4 different preparation techniques from in situ (no preparation) to dried and ground in a sample cup. Therefore, there were 48 precision data points for five of the instruments and 24 precision points for the MAP Spectrum Analyzer. The replicate measurements were taken using the source count times discussed at the beginning of this section.

For each detectable analyte in each precision sample a mean concentration, standard deviation, and RSD was calculated for each analyte. The data presented in Table 4 is an average RSD for the precision samples that had analyte concentrations at 5 to 10 times the lower limit of detection for that analyte for each instrument. Some analytes such as mercury, selenium, silver, and thorium were not detected in any of the precision samples so these analytes are not listed in Table 4. Some analytes such as cadmium, nickel, and tin were only detected at concentrations near the lower limit of detection so that an RSD value calculated at 5 to 10 times this limit was not possible.

One FPXRF instrument collected replicate measurements on an additional nine soil samples to provide a better assessment of the effect of sample preparation on precision. Table 5 shows these results. These data are provided for guidance purposes only. The additional nine soil samples were comprised of three from each texture and had analyte concentrations ranging from near the lower limit of detection for the FPXRF analyzer to thousands of mg/kg. The FPXRF analyzer only collected replicate measurements from three of the preparation methods; no measurements were collected from the in situ homogenized samples. The FPXRF analyzer conducted five replicate measurements of the in situ field samples by taking measurements at five different points within the 4-inch by 4-inch sample square. Ten replicate measurements were collected for both the intrusive undried and unground and intrusive dried and ground samples contained in cups. The cups were shaken between each replicate measurement.

Table 5 shows that the precision dramatically improved from the in situ to the intrusive measurements. In general there was a slight improvement in precision when the sample was dried and ground. Two factors caused the precision for the in situ measurements to be poorer. The major factor is soil heterogeneity. By moving the probe within the 4-inch by 4-inch square,

measurements of different soil samples were actually taking place within the square. Table 5 illustrates the dominant effect of soil heterogeneity. It overwhelmed instrument precision when the FPXRF analyzer was used in this mode. The second factor that caused the RSD values to be higher for the in situ measurements is the fact that only five instead of ten replicates were taken. A lesser number of measurements caused the standard deviation to be larger which in turn elevated the RSD values.

13.6 Accuracy measurements -- Five of the FPXRF instruments (not including the MAP Spectrum Analyzer) analyzed 18 SRMs using the source count times and calibration methods given at the beginning of this section. The 18 SRMs included 9 soil SRMs, 4 stream or river sediment SRMs, 2 sludge SRMs, and 3 ash SRMs. Each of the SRMs contained known concentrations of certain target analytes. A percent recovery was calculated for each analyte in each SRM for each FPXRF instrument. Table 6 presents a summary of this data. With the exception of cadmium, chromium, and nickel, the values presented in Table 6 were generated from the 13 soil and sediment SRMs only. The 2 sludge and 3 ash SRMs were included for cadmium, chromium, and nickel because of the low or nondetectable concentrations of these three analytes in the soil and sediment SRMs.

Only 12 analytes are presented in Table 6. These are the analytes that are of environmental concern and provided a significant number of detections in the SRMs for an accuracy assessment. No data is presented for the X-MET 920 with the gas-filled proportional detector. This FPXRF instrument was calibrated empirically using site-specific soil samples. The percent recovery values from this instrument were very sporadic and the data did not lend itself to presentation in Table 6.

Table 7 provides a more detailed summary of accuracy data for one particular FPXRF instrument (TN 9000) for the 9 soil SRMs and 4 sediment SRMs. These data are provided for guidance purposes only. Table 7 shows the certified value, measured value, and percent recovery for five analytes. These analytes were chosen because they are of environmental concern and were most prevalently certified for in the SRM and detected by the FPXRF instrument. The first nine SRMs are soil and the last 4 SRMs are sediment. Percent recoveries for the four NIST SRMs were often between 90 and 110 percent for all analytes.

13.7 Comparability -- Comparability refers to the confidence with which one data set can be compared to another. In this case, FPXRF data generated from a large study of six FPXRF instruments was compared to SW-846 Methods 3050 and 6010 which are the standard soil extraction for metals and analysis by inductively coupled plasma. An evaluation of comparability was conducted by using linear regression analysis. Three factors were determined using the linear regression. These factors were the y-intercept, the slope of the line, and the coefficient of determination (r^2).

As part of the comparability assessment, the effects of soil type and preparation methods were studied. Three soil types (textures) and four preparation methods were examined during the study. The preparation methods evaluated the cumulative effect of particle size, moisture, and homogenization on comparability. Due to the large volume of data produced during this study, linear regression data for six analytes from only one FPXRF instrument is presented in Table 8. Similar trends in the data were seen for all instruments. These data are provided for guidance purposes only.

Table 8 shows the regression parameters for the whole data set, broken out by soil type, and by preparation method. These data are provided for guidance purposes only. The soil types are as follows: soil 1--sand; soil 2--loam; and soil 3--silty clay. The preparation methods are as follows: preparation 1--in situ in the field; preparation 2--intrusive, sample collected and homogenized; preparation 3--intrusive, with sample in a sample cup but sample still wet and not

ground; and preparation 4—intrusive, with sample dried, ground, passed through a 40-mesh sieve, and placed in sample cup.

For arsenic, copper, lead, and zinc, the comparability to the confirmatory laboratory was excellent with r^2 values ranging from 0.80 to 0.99 for all six FPXRF instruments. The slopes of the regression lines for arsenic, copper, lead, and zinc, were generally between 0.90 and 1.00 indicating the data would need to be corrected very little or not at all to match the confirmatory laboratory data. The r^2 values and slopes of the regression lines for barium and chromium were not as good as for the other for analytes, indicating the data would have to be corrected to match the confirmatory laboratory.

Table 8 demonstrates that there was little effect of soil type on the regression parameters for any of the six analytes. The only exceptions were for barium in soil 1 and copper in soil 3. In both of these cases, however, it is actually a concentration effect and not a soil effect causing the poorer comparability. All barium and copper concentrations in soil 1 and 3, respectively, were less than 350 mg/kg.

Table 8 shows there was a preparation effect on the regression parameters for all six analytes. With the exception of chromium, the regression parameters were primarily improved going from preparation 1 to preparation 2. In this step, the sample was removed from the soil surface, all large debris was removed, and the sample was thoroughly homogenized. The additional two preparation methods did little to improve the regression parameters. This data indicates that homogenization is the most critical factor when comparing the results. It is essential that the sample sent to the confirmatory laboratory match the FPXRF sample as closely as possible.

Sec. 11.0 of this method discusses the time necessary for each of the sample preparation techniques. Based on the data quality objectives for the project, an analyst must decide if it is worth the extra time necessary to dry and grind the sample for small improvements in comparability. Homogenization requires 3 to 5 min. Drying the sample requires one to two hours. Grinding and sieving requires another 10 to 15 min per sample. Lastly, when grinding and sieving is conducted, time has to be allotted to decontaminate the mortars, pestles, and sieves. Drying and grinding the samples and decontamination procedures will often dictate that an extra person be on site so that the analyst can keep up with the sample collection crew. The cost of requiring an extra person on site to prepare samples must be balanced with the gain in data quality and sample throughput.

13.8 The following documents may provide additional guidance and insight on this method and technique:

13.8.1 A. D. Hewitt, "Screening for Metals by X-ray Fluorescence Spectrometry/Response Factor/Compton K_α Peak Normalization Analysis," American Environmental Laboratory, pp 24-32, 1994.

13.8.2 S. Piorek and J. R. Pasmore, "Standardless, In Situ Analysis of Metallic Contaminants in the Natural Environment With a PC-Based, High Resolution Portable X-Ray Analyzer," Third International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals, Las Vegas, Nevada, February 24-26, 1993, Vol 2, pp 1135-1151, 1993.

13.8.3 S. Shefsky, "Sample Handling Strategies for Accurate Lead-in-soil Measurements in the Field and Laboratory," *International Symposium of Field Screening Methods for Hazardous Waste and Toxic Chemicals*, Las Vegas, NV, January 29-31, 1997.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction* available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th St., N.W. Washington, D.C. 20036, <http://www.acs.org>.

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1. Metorex, X-MET 920 User's Manual.
2. Spectrace Instruments, "Energy Dispersive X-ray Fluorescence Spectrometry: An Introduction," 1994.
3. TN Spectrace, Spectrace 9000 Field Portable/Benchtop XRF Training and Applications Manual.
4. Unpublished SITE data, received from PRC Environment Management, Inc.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

The following pages contain the tables referenced by this method. A flow diagram of the procedure follows the tables.

TABLE 1

EXAMPLE INTERFERENCE FREE LOWER LIMITS OF DETECTION

Analyte	Chemical Abstract Series Number	Lower Limit of Detection in Quartz Sand (milligrams per kilogram)
Antimony (Sb)	7440-36-0	40
Arsenic (As)	7440-38-0	40
Barium (Ba)	7440-39-3	20
Cadmium (Cd)	7440-43-9	100
Calcium (Ca)	7440-70-2	70
Chromium (Cr)	7440-47-3	150
Cobalt (Co)	7440-48-4	60
Copper (Cu)	7440-50-8	50
Iron (Fe)	7439-89-6	60
Lead (Pb)	7439-92-1	20
Manganese (Mn)	7439-96-5	70
Mercury (Hg)	7439-97-6	30
Molybdenum (Mo)	7439-93-7	10
Nickel (Ni)	7440-02-0	50
Potassium (K)	7440-09-7	200
Rubidium (Rb)	7440-17-7	10
Selenium (Se)	7782-49-2	40
Silver (Ag)	7440-22-4	70
Strontium (Sr)	7440-24-6	10
Thallium (Tl)	7440-28-0	20
Thorium (Th)	7440-29-1	10
Tin (Sn)	7440-31-5	60
Titanium (Ti)	7440-32-6	50
Vanadium (V)	7440-62-2	50
Zinc (Zn)	7440-66-6	50
Zirconium (Zr)	7440-67-7	10

Source: Refs. 1, 2, and 3

These data are provided for guidance purposes only.

TABLE 2
SUMMARY OF RADIOISOTOPE SOURCE CHARACTERISTICS

Source	Activity (mCi)	Half-Life (Years)	Excitation Energy (keV)	Elemental Analysis Range	
Fe-55	20-50	2.7	5.9	Sulfur to Chromium Molybdenum to Barium	K Lines L Lines
Cd-109	5-30	1.3	22.1 and 87.9	Calcium to Rhodium Tantalum to Lead Barium to Uranium	K Lines K Lines L Lines
Am-241	5-30	432	26.4 and 59.6	Copper to Thulium Tungsten to Uranium	K Lines L Lines
Cm-244	60-100	17.8	14.2	Titanium to Selenium Lanthanum to Lead	K Lines L Lines

Source: Refs. 1, 2, and 3

TABLE 3
SUMMARY OF X-RAY TUBE SOURCE CHARACTERISTICS

Anode Material	Recommended Voltage Range (kV)	K-alpha Emission (keV)	Elemental Analysis Range	
Cu	18-22	8.04	Potassium to Cobalt Silver to Gadolinium	K Lines L Lines
Mo	40-50	17.4	Cobalt to Yttrium Europium to Radon	K Lines L Lines
Ag	50-65	22.1	Zinc to Technicium Ytterbium to Neptunium	K Lines L Lines

Source: Ref. 4

Notes: The sample elements excited are chosen by taking as the lower limit the same ratio of excitation line energy to element absorption edge as in Table 2 (approximately 0.45) and the requirement that the excitation line energy be above the element absorption edge as the upper limit (L2 edges used for L lines). K-beta excitation lines were ignored.

TABLE 4
EXAMPLE PRECISION VALUES

Analyte	Average Relative Standard Deviation for Each Instrument at 5 to 10 Times the Lower Limit of Detection					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	6.54	NR	NR	NR	NR	NR
Arsenic	5.33	4.11	3.23	1.91	12.47	6.68
Barium	4.02	NR	3.31	5.91	NR	NR
Cadmium	29.84 ^a	NR	24.80 ^a	NR	NR	NR
Calcium	2.16	NR	NR	NR	NR	NR
Chromium	22.25	25.78	22.72	3.91	30.25	NR
Cobalt	33.90	NR	NR	NR	NR	NR
Copper	7.03	9.11	8.49	9.12	12.77	14.86
Iron	1.78	1.67	1.55	NR	2.30	NR
Lead	6.45	5.93	5.05	7.56	6.97	12.16
Manganese	27.04	24.75	NR	NR	NR	NR
Molybdenum	6.95	NR	NR	NR	12.60	NR
Nickel	30.85 ^a	NR	24.92 ^a	20.92 ^a	NA	NR
Potassium	3.90	NR	NR	NR	NR	NR
Rubidium	13.06	NR	NR	NR	32.69 ^a	NR
Strontium	4.28	NR	NR	NR	8.86	NR
Tin	24.32 ^a	NR	NR	NR	NR	NR
Titanium	4.87	NR	NR	NR	NR	NR
Zinc	7.27	7.48	4.26	2.28	10.95	0.83
Zirconium	3.58	NR	NR	NR	6.49	NR

These data are provided for guidance purposes only.

Source: Ref. 4

^a These values are biased high because the concentration of these analytes in the soil samples was near the lower limit of detection for that particular FPXRF instrument.

NR Not reported.

NA Not applicable; analyte was reported but was below the established lower limit detection.

TABLE 5

EXAMPLES OF PRECISION AS AFFECTED BY SAMPLE PREPARATION

Analyte	Average Relative Standard Deviation for Each Preparation Method		
	In Situ-Field	Intrusive-Undried and Unground	Intrusive-Dried and Ground
Antimony	30.1	15.0	14.4
Arsenic	22.5	5.36	3.76
Barium	17.3	3.38	2.90
Cadmium ^a	41.2	30.8	28.3
Calcium	17.5	1.68	1.24
Chromium	17.6	28.5	21.9
Cobalt	28.4	31.1	28.4
Copper	26.4	10.2	7.90
Iron	10.3	1.67	1.57
Lead	25.1	8.55	6.03
Manganese	40.5	12.3	13.0
Mercury	ND	ND	ND
Molybdenum	21.6	20.1	19.2
Nickel ^a	29.8	20.4	18.2
Potassium	18.6	3.04	2.57
Rubidium	29.8	16.2	18.9
Selenium	ND	20.2	19.5
Silver ^a	31.9	31.0	29.2
Strontium	15.2	3.38	3.98
Thallium	39.0	16.0	19.5
Thorium	NR	NR	NR
Tin	ND	14.1	15.3
Titanium	13.3	4.15	3.74
Vanadium	NR	NR	NR
Zinc	26.6	13.3	11.1
Zirconium	20.2	5.63	5.18

These data are provided for guidance purposes only.

Source: Ref. 4

^a These values may be biased high because the concentration of these analytes in the soil samples was near the lower limit of detection.

ND Not detected.

NR Not reported.

TABLE 6
EXAMPLE ACCURACY VALUES

Analyte	Instrument															
	TN 9000				TN Lead Analyzer				X-MET 920 (SiLi Detector)				XL Spectrum Analyzer			
	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD
Sb	2	100-149	124.3	NA	--	--	--	--	--	--	--	--	--	--	--	--
As	5	68-115	92.8	17.3	5	44-105	83.4	23.2	4	9.7-91	47.7	39.7	5	38-535	189.8	206
Ba	9	98-198	135.3	36.9	--	--	--	--	9	18-848	168.2	262	--	--	--	--
Cd	2	99-129	114.3	NA	--	--	--	--	6	81-202	110.5	45.7	--	--	--	--
Cr	2	99-178	138.4	NA	--	--	--	--	7	22-273	143.1	93.8	3	98-625	279.2	300
Cu	8	61-140	95.0	28.8	6	38-107	79.1	27.0	11	10-210	111.8	72.1	8	95-480	203.0	147
Fe	6	78-155	103.7	26.1	6	89-159	102.3	28.6	6	48-94	80.4	16.2	6	26-187	108.6	52.9
Pb	11	66-138	98.9	19.2	11	68-131	97.4	18.4	12	23-94	72.7	20.9	13	80-234	107.3	39.9
Mn	4	81-104	93.1	9.70	3	92-152	113.1	33.8	--	--	--	--	--	--	--	--
Ni	3	99-122	109.8	12.0	--	--	--	--	--	--	--	--	3	57-123	87.5	33.5
Sr	8	110-178	132.6	23.8	--	--	--	--	--	--	--	--	7	86-209	125.1	39.5
Zn	11	41-130	94.3	24.0	10	81-133	100.0	19.7	12	46-181	106.6	34.7	11	31-199	94.6	42.5

Source: Ref. 4. These data are provided for guidance purposes only.

n: Number of samples that contained a certified value for the analyte and produced a detectable concentration from the FPXRF instrument.

SD: Standard deviation; NA: Not applicable; only two data points, therefore, a SD was not calculated.

%Rec.: Percent recovery.

-- No data.

TABLE 7
EXAMPLE ACCURACY FOR TN 9000^a

Standard Reference Material	Arsenic			Barium			Copper			Lead			Zinc		
	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.
RTC CRM-021	24.8	ND	NA	586	1135	193.5	4792	2908	60.7	144742	149947	103.6	546	224	40.9
RTC CRM-020	397	429	92.5	22.3	ND	NA	753	583	77.4	5195	3444	66.3	3022	3916	129.6
BCR CRM 143R	--	--	--	--	--	--	131	105	80.5	180	206	114.8	1055	1043	99.0
BCR CRM 141	--	--	--	--	--	--	32.6	ND	NA	29.4	ND	NA	81.3	ND	NA
USGS GXR-2	25.0	ND	NA	2240	2946	131.5	76.0	106	140.2	690	742	107.6	530	596	112.4
USGS GXR-6	330	294	88.9	1300	2581	198.5	66.0	ND	NA	101	80.9	80.1	118	ND	NA
NIST 2711	105	104	99.3	726	801	110.3	114	ND	NA	1162	1172	100.9	350	333	94.9
NIST 2710	626	722	115.4	707	782	110.6	2950	2834	96.1	5532	5420	98.0	6952	6476	93.2
NIST 2709	17.7	ND	NA	968	950	98.1	34.6	ND	NA	18.9	ND	NA	106	98.5	93.0
NIST 2704	23.4	ND	NA	414	443	107.0	98.6	105	106.2	161	167	103.5	438	427	97.4
CNRC PACS-1	211	143	67.7	--	772	NA	452	302	66.9	404	332	82.3	824	611	74.2
SARM-51	--	--	--	335	466	139.1	268	373	139.2	5200	7199	138.4	2200	2676	121.6
SARM-52	--	--	--	410	527	128.5	219	193	88.1	1200	1107	92.2	264	215	81.4

Source: Ref. 4. These data are provided for guidance purposes only.

^a All concentrations in milligrams per kilogram.

%Rec.: Percent recovery; ND: Not detected; NA: Not applicable.

-- No data.

TABLE 8

EXAMPLE REGRESSION PARAMETERS FOR COMPARABILITY¹

	Arsenic				Barium				Copper			
	n	r ²	Int.	Slope	n	r ²	Int.	Slope	n	r ²	Int.	Slope
All Data	824	0.94	1.62	0.94	1255	0.71	60.3	0.54	984	0.93	2.19	0.93
Soil 1	368	0.96	1.41	0.95	393	0.05	42.6	0.11	385	0.94	1.26	0.99
Soil 2	453	0.94	1.51	0.96	462	0.56	30.2	0.66	463	0.92	2.09	0.95
Soil 3	—	—	—	—	400	0.85	44.7	0.59	136	0.46	16.60	0.57
Prep 1	207	0.87	2.69	0.85	312	0.64	53.7	0.55	256	0.87	3.89	0.87
Prep 2	208	0.97	1.38	0.95	315	0.67	64.6	0.52	246	0.96	2.04	0.93
Prep 3	204	0.96	1.20	0.99	315	0.78	64.6	0.53	236	0.97	1.45	0.99
Prep 4	205	0.96	1.45	0.98	313	0.81	58.9	0.55	246	0.96	1.99	0.96

	Lead				Zinc				Chromium			
	n	r ²	Int.	Slope	n	r ²	Int.	Slope	n	r ²	Int.	Slope
All Data	1205	0.92	1.66	0.95	1103	0.89	1.86	0.95	280	0.70	64.6	0.42
Soil 1	357	0.94	1.41	0.96	329	0.93	1.78	0.93	—	—	—	—
Soil 2	451	0.93	1.62	0.97	423	0.85	2.57	0.90	—	—	—	—
Soil 3	397	0.90	2.40	0.90	351	0.90	1.70	0.98	186	0.66	38.9	0.50
Prep 1	305	0.80	2.88	0.86	286	0.79	3.16	0.87	105	0.80	66.1	0.43
Prep 2	298	0.97	1.41	0.96	272	0.95	1.86	0.93	77	0.51	81.3	0.36
Prep 3	302	0.98	1.26	0.99	274	0.93	1.32	1.00	49	0.73	53.7	0.45
Prep 4	300	0.96	1.38	1.00	271	0.94	1.41	1.01	49	0.75	31.6	0.56

Source: Ref. 4. These data are provided for guidance purposes only.

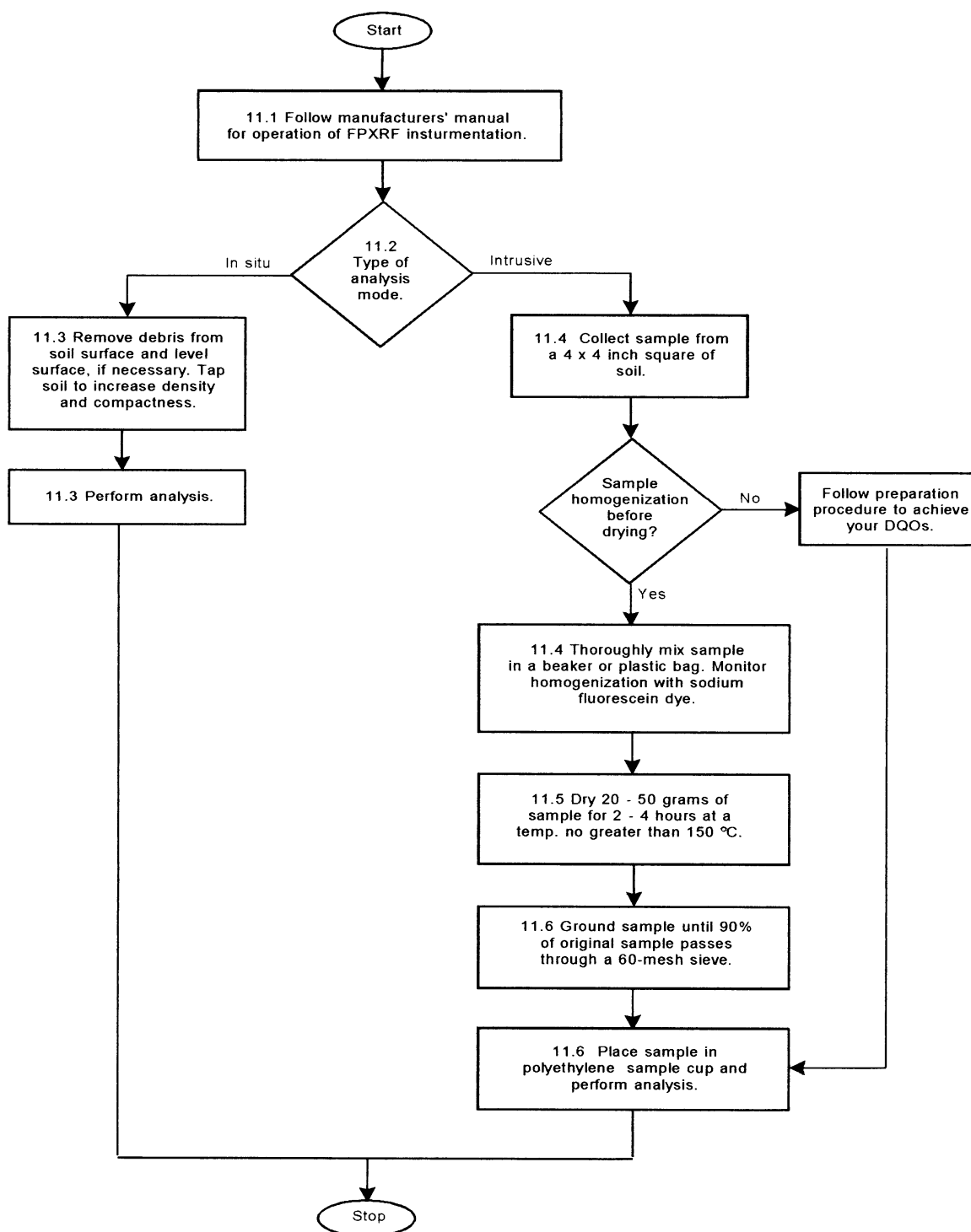
¹ Log-transformed data

n: Number of data points; r²: Coefficient of determination; Int.: Y-intercept

— No applicable data

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT



Appendix E

Phase I and II Environmental Site
Assessment – TtNUS, Inc.

Phase I and II Environmental Site Assessment for Detroit Atwater

**UNITED STATES COAST GUARD
DETROIT, MICHIGAN**



**Department of Transportation
United States Coast Guard
Civil Engineering Unit Cleveland
Contract Number - DTCG83-99-D-3CL277
Task Order Number - DTCG83-01-F-3CL134
USCG Project Number 09-C9277**

**DECEMBER 2001
REVISED DECEMBER 2002**

Phase I and II Environmental Site Assessment

for

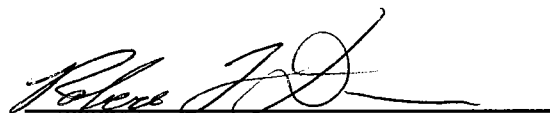
Detroit Atwater

**Department of Transportation
United States Coast Guard
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Contract Number – DTCG83-99-D-3CL277
Task Order Number – DTCG83-01-F-3CL134
USCG Project Number 09-C9277**

**Submitted by:
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**DECEMBER 2001
REVISED DECEMBER 2002**

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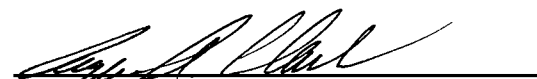

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ACRONYMS

ACM	Asbestos Containing Material
AST	Aboveground Storage Tank
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFATF	Civilian Federal Agency Task Force
CORRACTS	Corrective Action Report
DPT	Direct Push Technology
EDR	Environmental Data Resources, Inc.
EPA	Environmental Protection Agency
ERNS	Emergency Response Notification System
ESA	Environmental Site Assessment
FSP	Field Sampling Plan
ID	Inside Diameter
IDW	Investigation Derived Waste
LBP	Lead Based Paint
LUST	Leaking Underground Storage Tank
MDEQ	Michigan Department of Environmental Quality
msl	Mean Sea Level
MTBE	Methyl tertiary-butyl ether
MSO	Marine Safety Office
NFRAP	No Further Remedial Action Planned
NPL	National Priorities List
PAHs	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PRP	Potentially Responsible Party
RAATS	RCRA Administrative Action Tracking System
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SOP	Standard Operating Procedure
SVOCs	Semivolatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
TtNUS	Tetra Tech NUS, Inc.
TSD	Treatment, Storage, and Disposal

USCG	United States Coast Guard
USGS	United States Geological Survey
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

In accordance with the terms and conditions of Tetra Tech NUS, Inc.'s (TtNUS) contract number DTG83-99-D-3CL277 and the authorization of the United States Coast Guard (USCG) of TtNUS' proposal dated 13 March 2001 (Task Order DTG83-01-F3CL134, USCG Project Number 09-C9277), TtNUS has conducted a Phase I and II Environmental Site Assessment (ESA) at the Detroit Atwater Property in the City of Detroit, Wayne County, Michigan. The purpose of this study was to evaluate past and existing environmental conditions at the site, including the storage, release, or disposal of hazardous substances on the parcel. In order to achieve this objective, TtNUS has reviewed reasonably ascertainable published maps, aerial photographs, and available regulatory agency records; conducted a site reconnaissance; and interviewed persons having knowledge of prior site uses or potential environmental impairments. Based on the review of the information above for the Phase I ESA, it was recommended that a Phase II ESA be conducted consisting of limited subsurface exploration, soil sampling, and analytical laboratory testing.

Existing appurtenances at the subject site include two buildings on a 1.26-acre piece of property. The site also includes two slips for docking of boats. Part of the one slip was filled in with material from an unknown source between 1897 and 1922. Historical use of the facility by the Army Corps of Engineers (approximately 1922 to 1961) included engine rebuilding and by the USCG (approximately 1961 to present) included outboard engine maintenance and general storage. The vicinity within a one-mile radius of the subject property is commercial or industrially developed land.

The subject site is not identified by the State of Michigan or the federal government as being considered for remedial action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or other environmental legislation. No physical or documented evidence of underground storage tanks (UST) related to the subject property was found. However, a former aboveground storage tank (AST) was located at the south end of the property near the boat slip. No staining was observed in this area. There were no reported leaks when the tank was removed (date unknown), but there is no physical documentation on the tank closure. An oil and gas storage area was identified on a 1939 drawing. There is no documentation on the closure of this area.

Four small quantity Resource Conservation and Recovery Act (RCRA) generator facilities, three state hazardous waste sites, fourteen leaking underground storage tanks, and a coal gas facility appear on the regulatory database search within a one-half mile radius of the subject site. Based on the review of available data, it is unlikely that these sites have impacted USCG Detroit Atwater facility.

The USCG conducted a lead base paint survey and a limited asbestos survey in 1997. The analysis of ten paint chip samples indicated that all the paint chip samples contained lead. The samples were collected from interior painted surfaces of the Atwater building and from exterior painted surfaces of the overhead door and frame of the Atwater garage. Only one sample was collected for analysis of asbestos. The analysis of the one ceiling tile sample indicated the sample did not contain asbestos. An additional asbestos survey is recommended because several other possible asbestos - containing building materials (pipe insulation, floor tile, mastic) were observed during the site reconnaissance. The condition of these building materials was good.

In summary, a review of the existing data indicates that the site activities or activities occurring at adjacent sites do not appear to have adversely affected environmental conditions at the subject site. This Phase I ESA uncovered no apparent areas of significant environmental concern that would require rectification prior to transfer of the property, however further investigation of other possible asbestos - containing building materials, the AST, oil and gas storage area, and the filled-in slip should be considered.

The Phase II ESA consisted of limited sampling at three (3) areas of concern (the AST, oil and gas storage area, and filled-in slip area) identified in the December 2001 draft Phase I ESA. During the Phase II ESA field activities seven soil samples were collected for laboratory analysis. The results of the laboratory analysis indicated that:

- No BTEX, MBTE, or lead were detected at concentrations that exceed the MDEQ Part 201 Generic Cleanup Criteria and Screening Levels Residential criteria in the AST area.
- No BTEX or MBTE were detected in the former oil and gas storage area. PAHs were detected in the soil samples but the concentrations were less than the MDEQ residential criteria. Lead was detected at a concentration that exceeded the MDEQ residential criteria in one of the three soil samples but the average lead concentration for the three samples was less than the MDEQ residential criteria.
- Benzo(a)pyrene, arsenic, lead, and selenium concentrations in the soil samples from the filled-in slip exceeded the MDEQ residential criteria. However, the average benzo(a)pyrene concentration for the three samples from this area was 1938 µg/kg, which is below the MDEQ residential criteria (200 µg/kg). The concentration of arsenic was within the concentration range for soil in the United States and the concentration of lead and selenium were slightly greater than the concentration range for soil in the United States as published by the United States Environmental Protection Agency.
- The location of this property is in an area that the land use is zoned as commercial and industrial. The results from the soil analysis were compared to the Michigan Industrial Direct Contact criteria and

showed that one soil sample (DASB07) exceeded the criteria for lead (1070 mg/kg compared to the criteria of 900 mg/kg). The average lead concentration is below the Michigan Industrial Direct Contact criteria.

In summary, the Phase I ESA revealed three areas of potential environmental concern, however the limited Phase II ESA field investigation consisting of the collection and analysis of seven soil samples indicated that most of the soil sample concentrations were less than the MDEQ criteria or were within an acceptable range. No areas of significant environmental concern require rectification prior to transfer of the property. TtNUS recommends prior to the property transfer of the subject site that proper postings and notifications be made related to the potential for lead and asbestos containing building materials.

1.0 INTRODUCTION

The following section discusses the purpose, scope of services, limitations and exceptions of this assessment, and the information sources and methodology used in preparing this report.

1.1 PURPOSE

The purpose of an Environmental Site Assessment (ESA) is to evaluate a particular property for contamination that might have arisen from historical operations and to assess whether these uses might have resulted in property contamination. Tetra Tech NUS, Inc. (TtNUS) has conducted this Phase I and II ESA in accordance with the guidelines set forth in the Civilian Federal Agency Task Force (CFATF) Guide on Evaluating Environmental Liability For Property Transfers (CFATF, 1998) and TtNUS' proposal to the United States Coast Guard (USCG), dated 13 March 2001.

1.2 SCOPE OF SERVICES

The purpose of this assessment was to evaluate past and existing environmental conditions at the site, including the storage, release, or disposal of hazardous substances. Specifically, TtNUS conducted or oversaw the following services:

- Evaluation and description of past and current activities at the site and adjacent sites based on a data search and interviews.
- Site reconnaissance by a qualified environmental professional to evaluate the presence of conditions that may indicate an actual or potential release of hazardous substances at the site. Photographs obtained during the reconnaissance are included as Appendix A of this report.
- Review of reasonably ascertainable historical topographic and Sanborn maps and aerial photographs pertaining to the site vicinity. Topographic maps from the years 1952, 1968, 1973, and 1980; Sanborn maps from the years 1884, 1897, 1922, 1950, 1953, 1957, 1961, 1977, 1988, and 1991; and aerial photographs from the years 1937, 1957, 1972, 1985, and 1994 were reviewed. The purpose of this review was to gain a general understanding of prior uses of the site and surrounding area. Copies of the maps and aerial photographs are included in Appendix B.
- Evaluation of past treatment, recycling, or disposal of hazardous materials on the parcel. An environmental records search of state and federal environmental files was conducted. A copy of the

records search conducted by Environmental Data Resources, Inc. (EDR) is included as Appendix C of this report.

- Evaluation of the limited asbestos and lead base paint report was conducted. A copy of the report is included as Appendix D of this report.
- Evaluation of potential sources of off-site contamination within a reasonable distance of the site that may have impacted the site.
- Review of geologic and hydrogeologic literature pertaining to the site vicinity. The purpose of this review was to gain a basic understanding of subsurface conditions at the site.
- Review of radon information pertaining to the site vicinity. The purpose of this review was to gain a basic understanding of the potential for the presence of radon in the buildings on the site. Radon information provided by EDR is included in Appendix C of this report.
- Preparation of this report presenting the preliminary findings, conclusions, and recommendations regarding suitability of the site from an environmental assessment perspective.
- Perform limited sampling at three (3) areas of concern identified in the December 2001 draft Phase I ESA

1.3 LIMITATIONS AND EXCEPTIONS OF ASSESSMENT

The preliminary conclusions and recommendations presented in this report are based on reasonable observations made at the site and research of available materials within the scope and budget of the contract. The information presented is relevant to the dates of the TtNUS site visit and should not be relied on to represent conditions at later dates. The opinions expressed herein are based on TtNUS' experience with similar studies and information obtained during this effort. If additional information becomes available, TtNUS requests the opportunity to review the information and modify the opinions, if necessary.

The TtNUS observations were limited to the surface area of the subject parcel and the contiguous sites. Limited subsurface observations of soil characteristics, soil sampling, and analytical laboratory testing were within the scope of this study. Sediment, groundwater, and surface water sampling and analytical laboratory testing were not within the scope of this study. In addition, this limited study included a 50-year chain of title review. The U.S. Army Corps of Engineers purchased the western half of the Detroit Atwater Property from

Mary L. McMillan in 1904 and the eastern half from John Pridgeon Estate Company December 30, 1938. On March 1, 1957, the property was transferred to the USCG. The Phase I ESA at the subject property was conducted by TtNUS expressly and solely for the USCG. Reliance upon the information, conclusions, or recommendations contained in this report for purposes other than the transfer of the subject property shall be at the sole liability of the party undertaking such use.

TtNUS' services have been conducted using the degree of care and skill ordinarily exercised, under similar circumstances, by environmental science consultants practicing in this or similar localities. No other warranty, expressed or implied, is made as to the professional opinions presented in this report. TtNUS is not responsible for the conclusions, opinions, or recommendations made by others based on this information.

This report was compiled based partially on information supplied to TtNUS from outside sources, other information that is in the public domain, and visual observations made at the property. The preliminary conclusions and recommendations herein are based solely on the information TtNUS obtained in compiling the report. TtNUS makes no warranty as to the accuracy of statements made by others that might be contained in the report, nor are other warranties or guarantees, expressed or implied, included or intended by the report, except that it has been prepared in accordance with the current generally accepted practices and standards consistent with the level of care and skill exercised under similar circumstances by other professional consultants or firms performing the same or similar services. This report is intended to be used by the party authorizing the ESA for the transfer of the property investigated. None of the work performed hereunder shall constitute or be represented as a legal opinion of any kind or nature but shall be a representation of findings of fact from records examined.

This evaluation does not address the presence of the following conditions unless specifically stated otherwise:

- Chemical compounds that naturally occur in the environment;
- Commonly used household cleaning products, building materials, and consumables that might be hazardous; and
- Contaminants or contaminant concentrations that are not currently a concern but that might be so under future regulatory standards.

1.4 INFORMATION SOURCES AND METHODOLOGY USED

This report was prepared in general accordance with CFATF Guide on Evaluating Environmental Liability for Property Transfers (CFATF, 1998). Information sources referenced during the completion of this report are summarized in Section 7.0.

2.0 PROPERTY DESCRIPTION

This section discusses the site location and description, site vicinity characteristics, description of structures, roads and other improvements, physical setting, and current uses of the site and adjacent sites.

2.1 SITE LOCATION AND DESCRIPTION

The Detroit Atwater Property consists of two structures on approximately 1.26 acres of harbor front land in downtown Detroit, Michigan. A maintenance building and a six-car garage are located on the site. The general site location is depicted in Figure 2-1, Site Location Map. A site map of the Detroit Atwater Property is provided as Figure 2-2.

2.2 SITE VICINITY CHARACTERISTICS

The site vicinity is predominately commercial/industrial. Property to the east is a parking lot for a boat dock/boat touring service, to the west is a bulk aggregate facility with three large silos, to the south is the Detroit River, and to the north is Atwater Street. According to a 1996 estimate, the population of the City of Detroit is 1,000,272.

2.3 CURRENT USE OF THE PROPERTY

The USCG currently uses the site and buildings for storage and minor maintenance. The USCG stores building materials, old bouys, and boat motors in the buildings. No chemicals or containers were observed or reportedly stored at the site.

2.4 DESCRIPTION OF STRUCTURES, ROADS, AND OTHER IMPROVEMENTS

The subject site is a former USCG Marine Safety Office (MSO) that consists of two separate buildings: a maintenance building and a six-car garage. Located in the northwestern corner of the property, the maintenance building was constructed in 1932 and is a two-story wood and brick structure. Located in the northeastern corner of the property, the six-car garage was also constructed in the 1930s and is a single-story wood and brick structure. Along the south and western side of the property is a slip for boats to dock.

The site is predominantly covered with asphalt. A small green belt is located on the eastern side of the maintenance building and was used as a planter for landscaping purposes. A fence with a locked gate is

located along Atwater Street and a fence is located on the eastern and western sides of the property to restrict access to the site.

2.4.1 Roads

The main route to and from the site is Atwater Street, which runs along the northern edge of the property. A locked gate is the only entrance to the property.

2.4.2 Potable Water

The City of Detroit supplies water to the site, but the water has been turned off. No drinking water wells were observed on the site. No historic drinking water wells were reported in the EDR environmental database search.

2.4.3 Wastewater

Wastewater is discharged from the facility through the City of Detroit sewer system.

2.5 PHYSICAL SETTING

The subject site is located in Detroit, Michigan, on the Detroit River, north of Windsor, Ontario, Canada in southeast Michigan. The Detroit River forms the southern boundary of the site and could be used to gain access to the property.

2.5.1 Climate

The Detroit, Michigan area's average annual temperature is approximately 48.6 degrees Fahrenheit (°F). The average monthly minimum temperatures range from 15.6°F in January to 59.6°F in August. Average monthly maximum temperatures range from 30.3°F in January to 83.3°F in July. The average annual precipitation is 32.62 inches with the maximum monthly average occurring in June and August, and the minimum in January and February.

2.5.2 Topography

The subject site is relatively flat and slopes gently south toward the Detroit River. The ground surface elevation in the vicinity of the site is approximately 580 feet above mean sea level (msl). Surface topography of the site vicinity is depicted on Figure 2-1.

2.5.3 Geology

Geologically, the site is located within the southeastern part of the Michigan Basin. The Michigan Basin received shallow- to deep-water sediments throughout much of the Paleozoic Era (extending from the Ordovician through the Pennsylvanian Periods). Lithologically, the sediments deposited during this time period produced a vast thickness of sandstones, siltstones, shales, limestones and evaporites. Based on generalized geologic mapping of the state (modified from Martin, 1957, Geological Map of Michigan), bedrock underlying the facility consists of the Lower Middle Devonian-age Dundee Limestone that typically ranges in thickness from 40 to 160 feet.

Although no borings were conducted during this Phase 1 investigation, some generalizations can be made based on the known regional geology of the Detroit area. Bedrock underlying the Atwater facility dips northwestward toward the central part of the state, which formed the Central Michigan Basin during the early Paleozoic Era. Structural strike of the bedrock formations throughout this area is essentially trending to the northeast. Depth to bedrock is unknown.

2.5.4 Hydrogeology

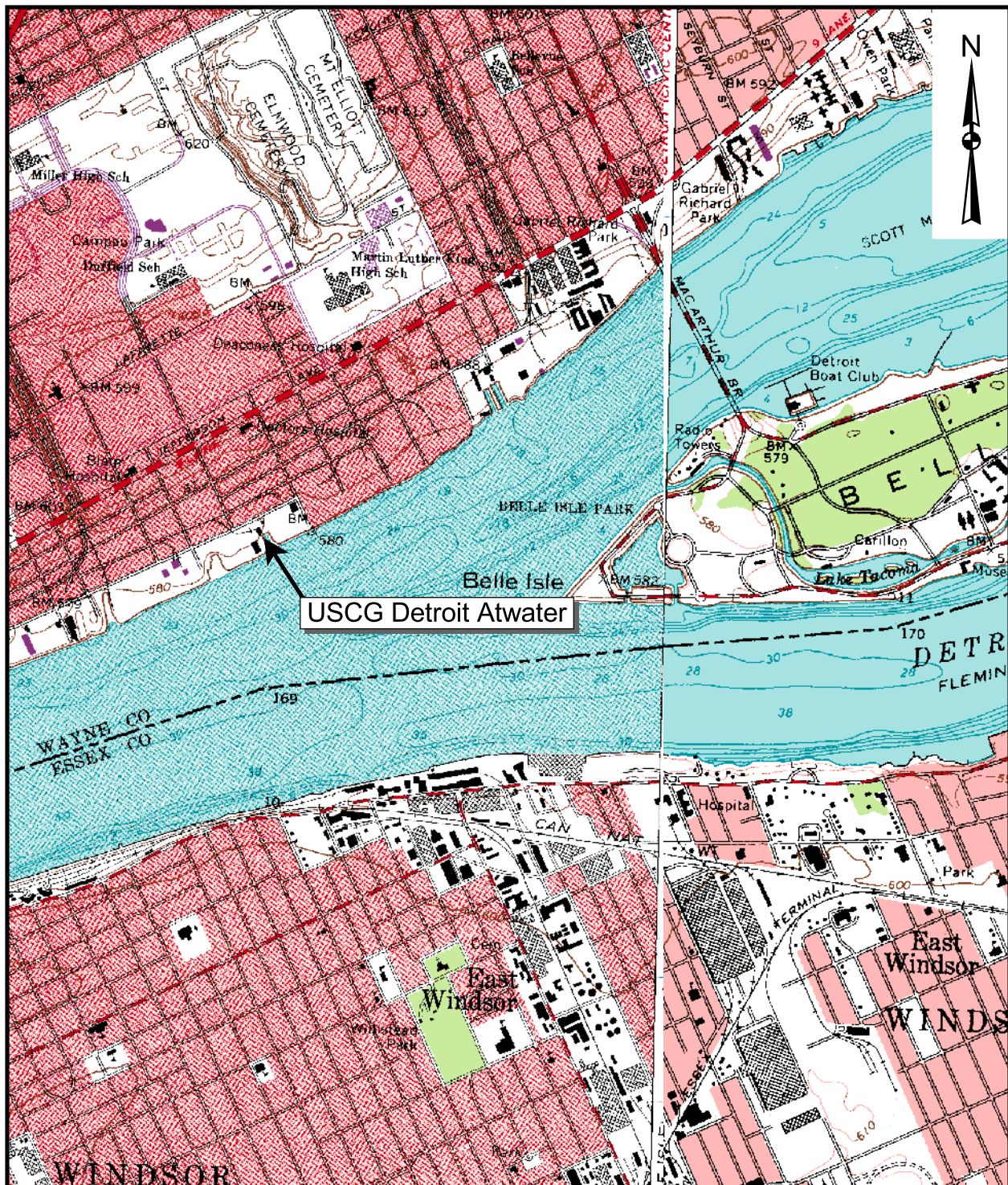
The Detroit River is located within a few hundred feet southeast of the facility. Topographically, the facility is at an elevation of approximately 580 above mean sea level and the surface slopes south to southeast toward the river. No wells are reportedly located at the subject facility, however Geocheck identified a well within one eighth of a mile of the facility. The well had an average depth to the water of 2 feet below ground surface. The wells in the local vicinity have a groundwater flow toward the northeast, although based on a review of the local topographic mapping, it is assumed that a component of the shallow groundwater flow would be toward the southeast toward the Detroit River. Sandy and silty unconsolidated soils assumed to be underlying the local area are characteristically high in permeability and would therefore allow relatively fast movement of any contaminants introduced into the saturated zone.

2.5.5 Soil Conditions

The ground surface at the Atwater facility appears to be a combination of native soil and reworked fill material, which is typical of properties along this riverfront area. The surface soil within the local area most likely has been derived from lacustrine material from the Detroit River and consists of gravel to clay. Based on data derived from the U.S. Department of Agriculture Soil Conservation Service STATSGO (State Soil Geographic Database), surface soil types within the area are characterized as clay loam to loamy fine sand and loamy sand. Deeper soil types consist of silt loam, sand, clay loam and silty clay. The depth to this deeper soil unit is listed as 60 inches but is unconfirmed.


2.6 CURRENT USES OF ADJACENT PROPERTIES

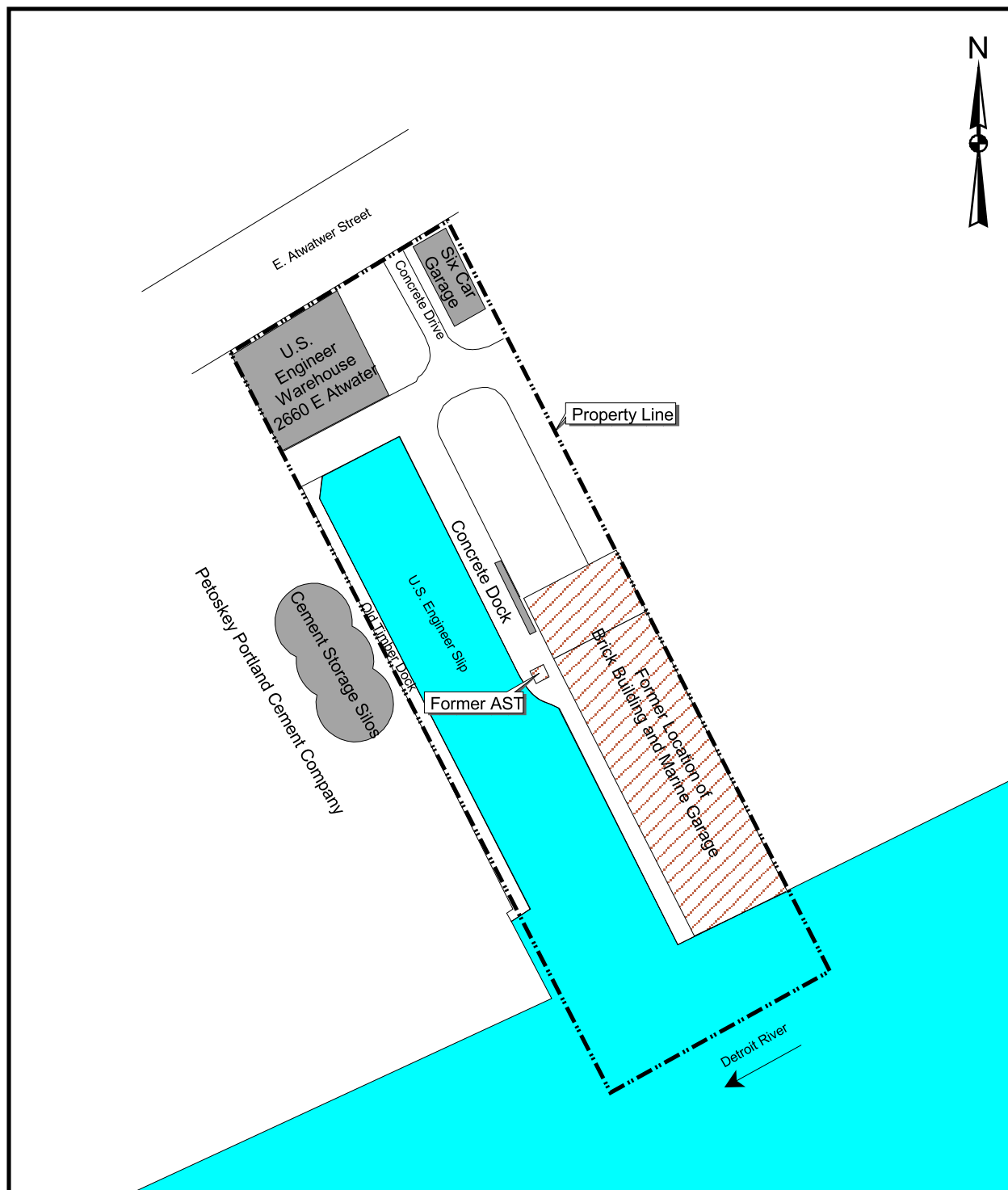
Surrounding the site are commercial/industrial properties. Most of these properties include two or more story brick structures. A parking lot for a boat dock/boat touring service borders the site on the east and a bulk aggregate facility on the west. The property across the street consists of a vacant two story brick warehouse.



2000 0 2000 Feet


Source: USGS Detroit, MI, 7.5' Digital Raster Graph

DRAWN BY MJJ		DATE 27Apr01			<p align="center">FIGURE 2-1</p> <p align="center">SITE LOCATION MAP</p> <p align="center">DETROIT</p> <p align="center">DETROIT, MICHIGAN</p>		CONTRACT NUMBER 099A			
CHECKED BY MF		DATE 04/30/01					APPROVED BY R. DAVIS		DATE 05/01/01	
COST/SCHEDULE-AREA							APPROVED BY DATE			
SCALE AS NOTED						DRAWING NO.		REV 0		



80 0 80 Feet

Source: U.S. Engineer Warehouse Dock Layout Plan dated Jan 28, 1942,
U.S. Army Corps of Engineers

DRAWN BY MJJ		DATE 27Apr01			<p align="center">FIGURE 2-2</p> <p align="center">SITE PLAN</p> <p align="center">DETROIT</p> <p align="center">DETROIT, MICHIGAN</p>		CONTRACT NUMBER 099A	
CHECKED BY MF		DATE 04/30/01					APPROVED BY R. DAVIS	DATE 05/01/01
COST/SCHEDULE-AREA							APPROVED BY	DATE
SCALE AS NOTED				DRAWING NO. 6618-D		REV 0		

3.0 HISTORICAL RECORDS REVIEW (SITE AND VICINITY)

The site history was constructed from a review of historical aerial photographs, topographic maps, Sanborn Maps, and interviews with persons having knowledge of previous site uses. The following discusses the information obtained from these sources:

3.1 AERIAL PHOTOGRAPHS

Date	Scale	Source	Description
1937	1" : 555.6'	USGS	Site and surrounding area are commercially/industrially developed. The maintenance building, garage, and boathouse are present. Property to the east is disturbed. (The property was cleared and earthmoving activities appeared to be occurring.)
1957	1" : 555.6'	USGS	Site and surrounding area are developed similar to 1937. The site and properties to the east and west appear the same as 1937.
1972	1" : 606.1'	USGS	Site and surrounding area are developed similar to 1937. Roads have been expanded. The properties to the east and west appear the same as 1937. The site is the same as 1937 except the boathouse may have been demolished (photograph is not clear) and the slip is present.
1985	1" : 666.7'	USGS	Site and surrounding area remain developed. The site and property to the west appear the same as 1972. Two slips are shown with the eastern slip on the property (where the boathouse was located) shorter than then the western slip, an indication that part of the slip may have been filled when the boathouse was constructed. The property to the east is a parking lot.
1994	1" : 606.1'	USGS	Site and surrounding area remain developed.
1999	1" : 333.3'	USGS	Site and surrounding area remain developed, similar to 1994.

3.2 TOPOGRAPHIC MAPS

Date	Scale	Source	Description
1952	1: 24,000	USGS	The boathouse is present as a structure, but the maintenance building and garage are not shown. The area is developed and some surrounding structures are shown.
1968	1: 24,000	USGS	The maintenance building and garage are shown, but the boathouse is not shown. The area is developed but few surrounding structures are shown.

Date	Scale	Source	Description
1973	1: 24,000	USGS	The map appears the same as the 1968 map.
1980	1: 24,000	USGS	The map appears the same as the 1968 map.

3.3 SANBORN MAPS

Date	Description
1884	The site includes a boathouse, two slips, and a boat shop. The eastern part of the site was owned by Grind Stone Ware Company. Properties to the east include slips, piles of wood, and a boat club. Properties to the north consist of a paper mill, homes, and a machine shop. Properties to the west consist of lumberyards, machine shops/mills, and an ice depot.
1897	New buildings at the north end of the site and slips are shown on the map. The boathouse and Grind Stone Ware Company on the 1884 map are gone. Two slips of approximately the same size are shown. The properties to the east and west also have slips. Surrounding properties consist of lumberyards, loading docks, and manufacturing (metal works, foundry) facilities.
1922	U.S. Engineers Building and the boathouse are on the site. The boathouse, constructed of a steel frame, wood, and brick, is located over the eastern slip on the property, but the slip length/boathouse is shorter than other slips, an indication that part of the slip may have been filled. The other building (garage) from the 1897 map is not present. Property to the east is a sand and gravel yard. Property to the west is a loading dock. Other surrounding properties appear to be involved with manufacturing (similar to 1897) and a coal company has replaced a previous lumberyard.
1950	The U.S. Engineers structure has been expanded and the six-car garage is shown. The boathouse has remained unchanged. The property to the east is a limestone and chemical company/gravel yard with a truck garage. The slip on this property is not shown, indicating that it may have been filled in. The property to the west is a cement company with circular silos for storage. Other surrounding properties are manufacturing (similar to 1922), but the coal yard is not identified.
1953	Appears the same as 1950.
1957	Similar to 1950 and 1953 except the property to the east has become a parking lot for the manufacturing facility (Northern Engineering Works) to the north. Northern Engineering has expanded its operations into the former coal yard property shown in 1922.
1961	Similar to 1957. The boathouse is identified as a USCG Reserve Training Center.
1977	Similar to 1961 except the site boathouse is not shown, and this area is vacant (there is no description of the condition or facilities for this area). The property to the west has three additional circular silos for cement storage.
1988	Similar to 1997 except the property to the west has the new silos shown on the 1977 map only. The buildings and old silos are not shown.
1991	Similar to 1988.

3.4 INTERVIEWS

The maintenance building was constructed in 1932 and the garage was constructed in the 1930s. The United States Army Corps of engineers occupied the site from approximately 1922 to 1961. Research of historical data regarding site occupation revealed that the United States Army Corps of Engineers used

the first floor of the building for maintenance of small boats and for storage and the second floor for administrative offices. The USCG purchased the property in 1961 and used the building in a similar fashion, the first floor for minor maintenance of machinery and engines and the second floor for administrative office buildings. The USCG reported that prior to 1980, the site was used by the MSO group that would check for spills on the waterway near Detroit. Spill cleanup materials were stored in the maintenance building and garage. From 1980 to the late 1980s, the MK group used the garage and first floor of the maintenance building for the repair of two-cycle engines. No records or knowledge of waste disposal activities were found. Currently, both floors of the building and the garage are used for storage.

3.5 USCG PHOTOGRAPHS AND DRAWINGS

The USCG provided several photographs and drawings of the site that are provided in Appendix E. Features to note are summarized below.

Photograph or File/Drawing	Date	Description
Exhibit 1		The area next to the boathouse appears to be the filled-in slip area.
2-4/5-RE	1939	Similar to the 1950 Sanborn Map indicating that the U.S. Engineering building expanded between 1922 and 1939. Oil and gas storage occurred at the north end of the slip.
D.D.R. 18/191	1942	Similar to previous drawings, but there is no indication of oil and gas storage.
1744-S	1968	The boathouse is not identified.
2592-S (many)	1972 (as-built)	The maintenance building was renovated. A machine shop was located on the first floor, eastern side of the building with most of the first floor being a repair shop and storage for small boats.

4.0 REGULATORY AGENCY RECORDS SEARCH

TtNUS reviewed federal and state of Michigan records to evaluate whether the subject site or properties within the site vicinity have been identified as having experienced significant unauthorized releases of hazardous substance or other events with potentially adverse environmental effects. EDR performed an environmental database search for the subject site for TtNUS. A copy of the report is included in Appendix C of this report.

4.1 FEDERAL ENVIRONMENTAL RECORD SOURCES

The sources that follow have been researched for sites in close proximity to the subject site.

4.1.1 United States Environmental Protection Agency, National Priorities List

The National Priority List (NPL) identifies hazardous material sites slated for cleanup under the federally sponsored Superfund program. The United States Environmental Protection Agency (EPA) has prioritized sites with significant risk to human health and the environment. These sites receive remedial funding under CERCLA. There were no such sites listed within a one-mile radius of the subject parcel.

4.1.2 United States Environmental Protection Agency, CERCLIS List

This list identifies hazardous material sites or environmental incidents recognized and listed on the federal level. Sites identified by the EPA that could release hazardous substances into the environment are also listed on the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) List. Sites to be included are identified primarily by the reporting requirements of hazardous substance treatment, storage, and disposal (TSD) facilities and releases larger than specific reportable quantities established by the EPA. There were no CERCLIS sites listed within a half-mile radius of the subject parcel.

CERCLIS listed sites that were designated as "No Further Remedial Action Planned (NFRAP)" were removed from the CERCLIS list, as of February 1995, and placed on the NFRAP list. There are no NFRAP sites listed within one-quarter mile radius of the subject site.

4.1.3 Federal NPL Liens List

A current list of federal NPL liens is compiled by the Office of Enforcement and Compliance Monitoring of the EPA based on information submitted by the EPA's ten regional offices. The subject property was not listed.

4.1.4 Resource Conservation and Recovery Information System

The Resource Conservation and Recovery Information System is compiled by the EPA, Office of Solid Waste and Emergency Response. This database contains information pertaining to facilities that generate, treat, store, or dispose of hazardous wastes regulated by the Resource Conservation and Recovery Act (RCRA). No RCRA TSD facilities were listed within a one-half mile radius of the subject parcel.

No large quantity RCRA generator facilities were listed within a one-quarter mile radius of the subject site. Four small quantity RCRA generator facilities were listed within a one-quarter mile radius of the subject site. Three of these were located within a one-eighth mile radius of the subject site. The sites were listed as follows:

The Stroh Companies, Inc., at 210 Chene Street, is located approximately 0.1 miles west of the subject property. May 13, 1993, two low priority violations regarding generator requirements and land ban requirements were reported at this site. The facility achieved compliance June 8, 1993.

Staff Industries, Inc, at 240 Chene Street, is located approximately 0.1 miles west-northwest of the subject property. No violations have been reported on this site.

Bluto, Inc., at 2720 Wight Street, is located approximately 0.125 miles north-northwest of the subject property. No violations have been reported on this site.

Dongan Electric Manufacturing Company, at 2987 Franklin Avenue, is located approximately 0.24 miles north-northeast of the subject property. No violations have been reported on this site.

The EPA maintains a database of RCRA facilities that are undergoing "corrective action" (CORRACTS). A corrective action order is issued, pursuant to RCRA Section 3008 (h), when there has been a release of hazardous waste or constituents into the environment from a RCRA facility. Corrective actions might be required beyond the facility's boundary and can be required regardless of when the release occurred, even if it predates RCRA. No such facilities were listed within a one-mile radius of the subject site.

The EPA's RCRA program identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRA Administrative Action Tracking System (RAATS) database contains records based on enforcement actions. The subject property was not listed on this database.

4.1.5 Emergency Response Notification System (ERNS)

The ERNS is a national database used to collect information on reported releases of oil and hazardous substances. This database contains information from spill reports made to federal authorities, including the EPA, the USCG, the National Response Center, and the Department of Transportation. No releases were listed as occurring on the subject property.

4.1.6 Toxic Release Inventory Database

Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (SARA Title III) requires the EPA to establish a database of facilities that release toxic chemicals in reportable quantities. This inventory is known as the Toxic Release Inventory System. Facilities subject to this reporting are required to complete a toxic chemical release form for specified chemicals. The subject property was not listed. Based on historical information provided by interviewed personnel, this site would not be expected to be required to report releases under this regulation.

4.1.7 USGS Wells - Federal Drinking Water Sources

The United States Geological Survey (USGS) maintains the Ground Water Site Inventory, a database of wells and groundwater sources. No water wells are registered within a one-mile radius of the subject site.

4.1.8 Sensitive Environmental Areas

The federal and state governments maintain databases related to sensitive environmental areas such as Federal Lands Data (Federal or state wilderness area, preserves, sanctuaries, or refuges; wild and scenic rivers; fish and wildlife; threatened or endangered species; etc.). No sensitive environmental areas were identified within 0.125- or one-mile of the subject site.

4.1.9 Historical and Cultural Significance

The federal and state governments maintain databases related to sites with historical and cultural significance. The subject property was not identified as a historical or cultural site. One site was identified within one-quarter mile of the site and several sites were identified within one-half mile and one-mile of the site.

4.2 STATE ENVIRONMENTAL RECORD SOURCES

4.2.1 State Hazardous Waste Sites (SHWS)

This list identifies the Michigan State Hazardous Waste Sites. These records are the state's equivalent to CERCLIS, although these sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds are identified along with sites where potentially responsible parties will pay for cleanup. The data come from the Department of Environmental Quality's Contaminated Sites List. Three sites were listed within a one-mile radius of the subject site. One of these is located within a one-eighth mile radius. The sites are listed as follows:

A.T. Wagner Property, at 2720 Wight Street in Detroit, MI is approximately 0.0625 miles northwest of the subject site and was identified as a site in late 1998. Contaminants at the site include trichloroethylene, tetrachloroethylene, and vinyl chloride. The database indicates that an evaluation and interim response were conducted by the potentially responsible party (PRP).

Michigan Con Gas Company Station B, at Jefferson and Meldrum in Detroit, MI is approximately 0.8 miles northeast of the subject site and was identified as a site in late 1991. Contaminants at the site include benzene, xylene, toluene, polynuclear aromatic hydrocarbons, and ethylbenzene. The database indicates an evaluation and interim response was conducted by the PRP.

Uniroyal Properties, at 6600 East Jefferson Avenue in Detroit, MI is approximately 0.9 miles northeast of the subject site and was identified as a site in mid-1992. Contaminants include benzene, toluene, ethylbenzene, xylene, polynuclear aromatic hydrocarbons, cyanide, and carbon disulfide. The database indicates an evaluation and interim response was conducted by the PRP.

4.2.2 Underground/Aboveground Storage Tanks (UST/AST)

The Michigan Department of Environmental Quality maintains a database with a comprehensive listing of registered underground (UST) and above ground (AST) storage tanks within the state of Michigan. One site with USTs was listed within a quarter mile radius of the subject site. The site is listed as Parker Majestic Property at 147 Joseph Campau in Detroit, MI and contains two USTs.

No ASTs or USTs were identified at the subject site in the Michigan Department of Environmental Quality database. No other documented evidence of USTs directly related to the site was found.

4.2.3 Leaking Underground Storage Tanks (LUST)

The Michigan Department of Environmental Quality maintains a database with a comprehensive listing of all registered leaking underground storage tanks within the state of Michigan. Fourteen sites with leaking underground storage tanks (LUSTs) were listed within a one-half mile radius of the subject site. Five of these 14 sites were within one-quarter mile of the subject property. The five sites are listed as follows:

Parker Majestic Property, at 147 Joseph Campau, is approximately 0.1 miles northeast of the subject site. The case is closed.

A demolished building, at 2700 Franklin Avenue, is approximately 0.16 miles north-northwest of the subject site. The case is closed.

Medusa Cement Company, at 2122 East Atwater Street, is approximately 0.25 miles west-southwest of the subject site. The case is open.

Comerica, Inc., at 2700 East Jefferson, is approximately 0.25 miles north-northwest of the subject site. The case is closed.

A vacant property, at 2661 East Jefferson, is approximately 0.25 miles northwest of the subject site. The case is closed.

4.2.4 Solid Waste Facility Database

The Michigan Department of Environmental Quality maintains a database with a comprehensive listing of solid waste disposal facilities or landfills within the state of Michigan. No sites with solid waste disposal facilities or landfills were listed within a one-half mile radius of the subject site.

4.2.5 State Drinking Water Sources

The Michigan Department of Environmental Quality maintains a database of state owned wells and groundwater sources. No water wells are registered within a one-mile radius of the subject site.

4.3 MUNICIPAL AND LOCAL AUTHORITY

TtNUS conducted the interview that follows. Other databases reviewed for sites within close proximity to the subject property are also discussed.

4.3.1 Agency Interview

TtNUS interviewed Mr. Ray Emond, General Foreman from the USCG and Lynn Keller, an Environmental Engineer from the USCG. TtNUS recommends that Mr. Emond and Ms. Keller be contacted regarding future site information needs. The questionnaires used to interview and used during the site reconnaissance are attached in Appendix F.

The USCG reported that the Atwater facility and surrounding properties are built on an old landfill/dump site. The Army Corps of Engineers also had an engine rebuilding facility on the property.

4.3.2 Independent Reports

EDR maintains a database that identifies the location of former coal gas sites. These sites may have disposed of byproducts from the coal gasification process. One site was located within a one-quarter mile radius of the subject parcel. The site is listed as follows:

Detroit Gas Company Chene Street Station, at 2660 Franklin and 38 Chene Street is located approximately 0.13 miles northwest of the subject property. The site is vacant.

4.4 SUMMARY

In summary, four small quantity RCRA generator facilities and one coal gas facility were listed within a one-quarter mile radius, and three state hazardous waste sites, fourteen leaking underground storage tanks and a coal gas site were listed within a one-half mile radius. The subject property does not utilize groundwater for any purpose. Domestic water is from a public utility and is currently turned off at the Detroit Atwater facility. This area of Detroit has sanitary sewers, and the Detroit Atwater facility is connected to it.

It is unlikely that the subject site has been impacted by an off-site release of hazardous materials or hazardous waste at this time.

5.0 SITE RECONNAISSANCE

5.1 SITE INSPECTION OBSERVATIONS

On May 10, 2001, TtNUS environmental scientist, Mr. A. Bennett conducted a ground survey assisted by Mr. Ray Emond, the USCG station's general foreman. Mr. Emond is responsible for the maintenance and construction at the station. Messrs. Bennett and Emond walked accessible portions of the subject site.

During the site inspection, TtNUS evaluated the existing environmental condition of the property and surrounding vicinity for environmental impairment resulting from past or current uses of hazardous materials or wastes. Areas of concern included the possible existence of USTs or ASTs, hazardous chemicals used on-site, hazardous materials and hazardous waste storage, improper disposal of hazardous substances, and the presence of polychlorinated biphenyls (PCBs), lead-based paint (LBP), and asbestos-containing material (ACM). Appendix A includes photographic documentation of the site inspection. Appendix F includes questionnaires used during the site visit to document the observations.

5.1.1 General Site Setting

The Detroit Atwater Property is a former USCG MSO station and is approximately 1.25 acres of harbor front land in downtown Detroit, Michigan. A former Reserve Training Building and a six-car garage are located on the site and are currently used for storage and minor maintenance. Two boat slips are located along the Detroit River. Property to the east is a parking lot for a boat dock/boat touring service, to the west is a bulk aggregate facility with 3 large silos, to the south is the Detroit River, and to the north is Atwater Street. The site is fairly level and gently slopes towards the Detroit River. The site features are depicted in Figure 2-2. The USCG currently retains the property.

5.1.2 Exterior Observations

The main building and the garage are both wood and brick structures. The single-story garage and the two-story building are both in good condition. The crew at the USCG-Detroit station maintains the site.

The remaining area surrounding the buildings is covered with asphalt and is used to store items such as boats, trailers, steel structures, pallets, drums, marker bouys, etc. There is a slip for boats on the western part of the property. The slip on the eastern part of the property is partially filled-in with square concrete anchors.

5.1.3 Interior Observations

A reconnaissance of the interior of the maintenance building was conducted. The first floor was used for maintenance and storage and the second floor for offices. The gas and water had both been turned off, but the building did have electricity. There were floor drains in the main room and in the boiler room that go to the City of Detroit sewage system.

A water line break in 1997 caused a flood in the building (see report in Appendix D). Samples from the floor and soil beneath showed no significant contamination. The wooded ground level floor showed some minor staining, caused by flooding or minor spills during maintenance (Geraghty & Miller, 1997).

The second floor, which was used for offices, is now used for storage of electrical materials.

5.1.4 Asbestos-Containing Material

During the site reconnaissance, no insulation was visible in the walls or ceiling. Pipe was wrapped with insulation but the surveyors could not gain access to determine if it contained asbestos. The insulation on the pipe appeared to be in good condition. On April 3, 1997, the USCG conducted a limited asbestos survey, during which a ceiling tile sample was collected and analyzed for asbestos. The report indicated that the sample was asbestos-free. The report is included in Appendix D.

5.1.5 Lead-Based Paint

On April 3, 1997, the USCG conducted a lead base paint survey. Eight samples of paint chips from the maintenance building and two samples of paint chips from the garage were collected and analyzed for lead. The samples contained lead, ranging from 0.107 percent to 19.4 percent by weight. The paint chip samples were collected from interior surfaces of the Atwater building and exterior surfaces of the overhead door and frame of the Atwater garage. The report is included in Appendix D. During the site reconnaissance peeling paint was observed in several areas (ceiling, columns) in the Atwater building and the paint was in good condition on the Atwater garage.

5.1.6 PCBs

No equipment potentially containing PCBs and no large transformers were observed at or adjacent to the buildings.

5.1.7 Underground Storage Tanks

No USTs were observed at or immediately adjacent to the buildings, and no regulatory agencies reported UST installation or removal records for the subject property.

5.1.8 Aboveground Storage Tanks

There is physical evidence of a former AST along the slip. According to Mr. Emond, the tank was installed around 1980 and was removed in the late 1980s and properly disposed. The AST contained unleaded gasoline. The electrical panel and piping remain with the former pad. No stains were observed in the area of the former AST. No documentation was available on the closure of the AST.

There is historical evidence of an oil and gas storage facility shown on the Corps of Engineers drawing (File No. 2-4/5-RE). This storage facility was located between the north end of the western slip and the maintenance building. No information is available on the closure of this facility.

5.1.9 Hazardous Chemicals

No evidence of hazardous chemicals or hazardous waste was observed at, or immediately adjacent to the buildings.

5.1.10 Stormwater

Stormwater from the site flows overland from north-northwest to south-southeast, and eventually enters the Detroit River.

5.1.11 Wetlands

Wetlands are identified based on vegetation, visible hydrology, or geography in accordance with the Classification of Wetlands and Deepwater Habitats. The US Fish and Wildlife Service maintains the National Wetlands Inventory, a Geographic Information System-based relational database of wetlands that have been mapped throughout the country.

Review of the NWI database and visual reconnaissance at the site indicates that the site is not a jurisdictional wetland. The Detroit River, a riverine wetland system, is the southern property line of the site. The site is mapped within the boundaries of the 500-year and the 100-year flood zones.

5.1.12 Radon

Based on the EDR database information pertaining to radon gas, the subject site is in an area classified as low risk for radon. The radon concentration reported at one site within this zip code area was 1.3 uCi/L in a basement, below the 4 pCi/L criteria.

5.1.13 Air Emissions

No chemical odors were noted on the subject property or the neighboring properties during the site reconnaissance.

5.2 PREVIOUS REPORTS

Data pertaining to asbestos and lead-based paint was reviewed, and is included herein as Appendix D. No other reports were provided or reviewed.

6.0 PHASE I CONCLUSIONS AND RECOMMENDATIONS

Based on a review of background data, regulatory agency records, aerial photographs, Sanborn Maps, topographic maps, information provided by the USCG, and observations made during the site reconnaissance (the Phase I ESA), the following conclusions and recommendations are presented regarding the subject site. The scope of this study did not include subsurface exploration, sampling, or analytical laboratory testing.

6.1 CONCLUSIONS

- The subject site consists of one piece of property with two buildings. Several buildings have been constructed and demolished on the site based on review of the Sanborn maps. The maintenance building was originally built between 1884 and 1897 and was improved between 1922 and 1950. The garage was also built between 1922 and 1950.
- The subject site has two slips for docking boats. According to the Sanborn maps, the two slips on the subject property as well as a slip on the neighboring property to the east were approximately the same size in 1897. Between 1897 and 1922, the slip on the eastern half of the subject property was partially filled in and a boathouse was constructed, and between 1922 and 1950, the slip on the neighboring property to the east was filled in. The composition of the fill material is not known. Between 1957 and 1982 (based on the Sanborn maps) or between 1952 and 1968 (based on the topographic maps), the boathouse was demolished.
- Historical use of the facility by the Army Corps of Engineers included engine rebuilding and by the USCG included outboard engine maintenance and general storage.
- The subject site is not identified as being evaluated by the State of Michigan or federal government for remedial action under CERCLA or other environmental regulations.
- Four small quantity RCRA generator facilities, three state hazardous waste sites, fourteen leaking underground storage tanks, and a coal gas facility appear on the regulatory database search within a one-half mile radius of the subject site. Based on available information, including the locations of these properties and the nature of the database listings, it is unlikely that the subject property has been impacted by unauthorized releases of hazardous substances at this time.
- AST and an Oil and Gas Storage area were identified at two locations on the property. Both locations were closed; however there is no documentation on the closure.

- No physical or documented evidence of USTs directly related to the subject site was found during the site reconnaissance.
- The USCG conducted a LBP survey on April 3, 1997. The results indicated that all ten paint chips contained lead. These paint chips were obtained from interior surfaces of the Atwater building and exterior surfaces of the overhead door and frame of the Atwater garage. During the site reconnaissance, peeling paint was observed in the Atwater building and the paint was in good condition on the Atwater garage.
- The USCG conducted a limited asbestos survey on April 3, 1997. One sample of ceiling tile was collected and the analysis for asbestos was negative. Several other possible asbestos containing building materials (pipe installation, floor tile, mastic) were observed during the site reconnaissance. These building materials appeared to be in good condition.
- In summary, this Phase I ESA revealed a few apparent areas of potential environmental concern that may require further investigation before the property is transferred.

6.2 RECOMMENDATIONS

- TtNUS recommends that an additional asbestos survey be completed for each building at the subject site. Samples of pipe insulation, floor tile, and mastic, and other potential ACM should be collected and analyzed.
- TtNUS recommends collection of soil samples and analysis for petroleum products (benzene, toluene, ethylbenzene, xylene, total petroleum hydrocarbons, and polynuclear aromatic hydrocarbons, typical constituents of petroleum products) at two locations, the former AST that contained unleaded gasoline and Oil and Gas Storage Area.
- TtNUS recommends collection and analysis of samples from the fill material in the slip area on the eastern half of the subject property that was partially filled in before construction of the boathouse.

7.0 PHASE II ESA FIELD ACTIVITIES

The field investigation for USCG Detroit Atwater site was performed on August 14, 2002. The activities consisted of subsurface soil sampling. These field activities supported the collection of data to meet the objective of characterizing the three previously identified areas of potential environmental concern (the AST, oil and gas storage, and filled-in slip areas) as potential hazards or liability. Photographs of the field activities are provided in Appendix A.

A summary of the field investigation sampling rationale is presented in Table 7-1. The following sections discuss the field activities conducted and the site-specific geologic and hydrogeologic characteristics at the Detroit Atwater site. A summary of the Phase II ESA sampling activities is provided in Table 7-2. The layout of the site with the location of the soil borings is shown in Figure 7-1.

7.1 FIELD INVESTIGATION

The following sections discuss the activities conducted for the Phase II ESA at the USCG Detroit Atwater site. The specific field activities conducted during this investigation are discussed, including subsurface soil collection, investigation-derived waste (IDW) management, and the abandonment of the soil borings.

The activities were conducted to meet requirements of the Field Sampling Plan (FSP) for the Phase II ESA at USCG Detroit Atwater (TtNUS, July 2002) specifically for this investigation. A TtNUS geologist supervised the drilling activities and reviewed the field documentation. The field activities followed TtNUS Standard Operating Procedures (SOPs).

7.1.1 Direct Push Technology Drilling

Direct Push Technology (DPT) involves pushing tools hydraulically or mechanically into the ground to the desired depth. This method was used to collect subsurface soil samples at locations throughout the Detroit Atwater site. The soil samples were collected in 1.5-inch inside diameter (ID), 4-foot long acetate liners. The surface and subsurface samples were collected from the same soil boring. The soil cuttings were placed in a 5-gallon plastic bucket and sampled to characterize the waste for disposal.

7.1.2 Subsurface Soil Sampling

Soil samples were collected from seven of the nine proposed soil borings using DPT methods. DASB01 through DASB03 and DASB06 through DASB09 were sampled from intervals within a depth range of 1 to 9 feet below ground surface. DASB04 and DASB05 were not sampled due to concrete refusal. The soil samples were analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) and methyl tertiary-butyl

ether (MTBE) (USEPA Method 8060B), polynuclear aromatic hydrocarbons (PAHs) (USEPA Method 8270C), lead (USEPA Method 6010B), volatile organic compounds (VOCs) (USEPA Method 5035/5030/8260B), semivolatile organic compounds (SVOCs) (USEPA Method 8270C), Pesticides/PCBs (USEPA Method 8082/8081A), and the RCRA Metals (USEPA Method 6010B). These samples were collected to provide information for the Phase II ESA. Accutest Laboratories, under subcontract with TtNUS, analyzed the samples. Accutest was used because it is a National Environmental Laboratory Accreditation Program certified laboratory and MDEQ does not certify laboratories.

Upon retrieval, the entire soil sample visually classified for lithology, soil moisture, and other pertinent observations. This information is located on boring logs that are found in Appendix G. Copies of the soil sample log sheets are also provided in Appendix G. A summary of the subsurface soil samples collected is presented on Table 7-2.

Samples designed for VOC, BTEX, and MTBE analysis were collected by adding 3 to 5 grams of soil into three 40-ml vials, one pre-preserved with methanol and two pre-preserved with a sodium bisulfate solution. The soil samples designated for PAHs, SVOCs, Pesticides/PCBs, RCRA metals, and lead were placed in sample jars. The soil samples were placed on ice in coolers immediately after collection and shipped to Accutest Laboratory in Orlando, Florida for chemical analysis. The signed chain-of-custody can be found in Appendix G.

7.1.3 Soil Boring Abandonment

After a boring was drilled and sampled, the boring was backfilled. Boreholes were backfilled with bentonite chips and hydrated per the manufactures specifications to within 6-inches of ground surface and then topped off with neat cement. Imaging Subsurface, Inc., a DPT subcontractor, performed the soil boring abandonment according to Michigan State regulations.

7.1.4 Investigation-Derived Waste

Because DPT was used to collect the soil samples, only minimal IDW was generated. During the investigation soil cuttings generated from the sampling activities were containerized in a 5-gallon plastic bucket and stored on-site. There was no liquid IDW generated during the field investigation. Other IDW such as trowels, paper towels, macrocore sampling sleeves, etc. were double bagged and placed in USCG Detroit Atwater trash receptacles (dumpsters). Following the investigation, a composite soil sample was collected and submitted for laboratory analysis for Toxicity Characteristic Leaching Procedure (TCLP) analysis to characterize the soil for disposal. The results from the analysis of the IDW composite soil sample characterized the soil as non-hazardous. The IDW was handled in accordance

with the project FSP (TtNUS, July 2002). The 5-gallon plastic bucket was removed from the site on September 27, 2002 and disposed by Waste Management.

7.2 SITE SPECIFIC GEOLOGY

Geologic conditions at the Detroit Atwater site were characterized as part of the Phase II ESA. Surface and subsurface materials at the site were visually classified based on macrocore samples collected during the drilling of soil borings during TtNUS field investigation.

The shallow subsurface lithology of the site was characterized to a depth of 9 feet and consists of 4 to 4.5 feet of fill and concrete overlying 4 feet of gravelly to organic clay. Soils obtained beneath the clay layer from 8 to 9 feet below ground surface is characterized as gravelly to silty sand.

7.3 SITE SPECIFIC HYDROGEOLOGY

The hydrogeologic conditions at the Detroit Atwater site were interpreted from data collected during the subsurface investigation activities at the site. The shallow aquifer at the site is composed primarily of unconsolidated fill, sands, and clays. The investigation was conducted to a depth of 9 feet below ground surface. In general, the water table within these heterogeneous soils is shallow and is typically encountered at a depth of 5 feet below ground surface at the site, the approximate same elevation of the Detroit River. Groundwater flow direction is assumed to be southeast towards the Detroit River.

TABLE 7-1

**SAMPLING RATIONALE
USCG DETROIT ATWATER
DETROIT, MICHIGAN**

Sample Location	Sampling Rationale
Subsurface Soil	
DASB01	Collected to assess whether site-related chemicals are present at the Former Oil and Gas Storage Area.
DASB02	Collected to assess whether site-related chemicals are present at the Former Oil and Gas Storage Area.
DASB03	Collected to assess whether site-related chemicals are present at the Former Oil and Gas Storage Area.
DASB04	Collected to assess whether site-related chemicals are present at the former AST that contained gasoline. The soil sample from the soil boring was not sampled due to concrete refusal.
DASB05	Collected to assess whether site-related chemicals are present at the former AST that contained gasoline. The soil sample from the soil boring was not sampled due to concrete refusal.
DASB06	Collected to assess whether site-related chemicals are present at the former AST that contained gasoline.
DASB07	Collected to characterize the fill materials used to backfill the former slip area.
DASB08	Collected to characterize the fill materials used to backfill the former slip area.
DASB09	Collected to characterize the fill materials used to backfill the former slip area.

TABLE 7-2
SAMPLING SUMMARY
PHASE II ENVIRONMENTAL SITE INVESTIGATION REPORT
USCG DETROIT ATWATER
DETROIT, MICHIGAN

SAMPLE NAME	Depth (feet bgs)	BTEX & MTBE	PAHs	LEAD	VOCs	SVOCs	PESTICIDES & PCBs	RCRA METALS ⁽¹⁾	TCLP ⁽⁴⁾
SOIL SAMPLES									
DASB010607	6.0 - 7.0	X	X	X					
DASB020607	6.0 - 7.0	X	X	X					
DASB030406	4.0 - 6.0	X	X	X					
DAFD010607 ⁽²⁾	6.0 - 7.0	X	X	X					
DASB061112	11.0 - 12.0			X					
DASB070304	3.0 - 4.0				X	X	X	X	
DASB080304	3.0 - 4.0				X	X	X	X	
DASB090304	3.0 - 4.0				X	X	X	X	
DAFD020304 ⁽³⁾	3.0 - 4.0				X			X	
INVESTIGATION DERIVED WASTE									
DAIDW01									X

1. Includes Arsenic, Barium, Chromium, Cadmium, Lead, Mercury, Selenium, and Silver.

2. Duplicate sample of DASB010607

3. Duplicate sample of DASB080304

4. TCLP analysis for VOCs, SVOCs, Pesticides/Herbicides, and metals.

Notes:

bgs - below ground surface

BTEX - Benzene, Toluene, Ethylbenzene, and Total Xylene

MTBE - Methyl tertiary-butyl ether

PAHs- Polynuclear Aromatic Hydrocarbons

VOC - Volatile Organic Compound

SVOC- Semi-Volatile Organic Compounds

PCBs- Polychlorinated Biphenyl

RCRA - Resource Conservation and Recovery Act

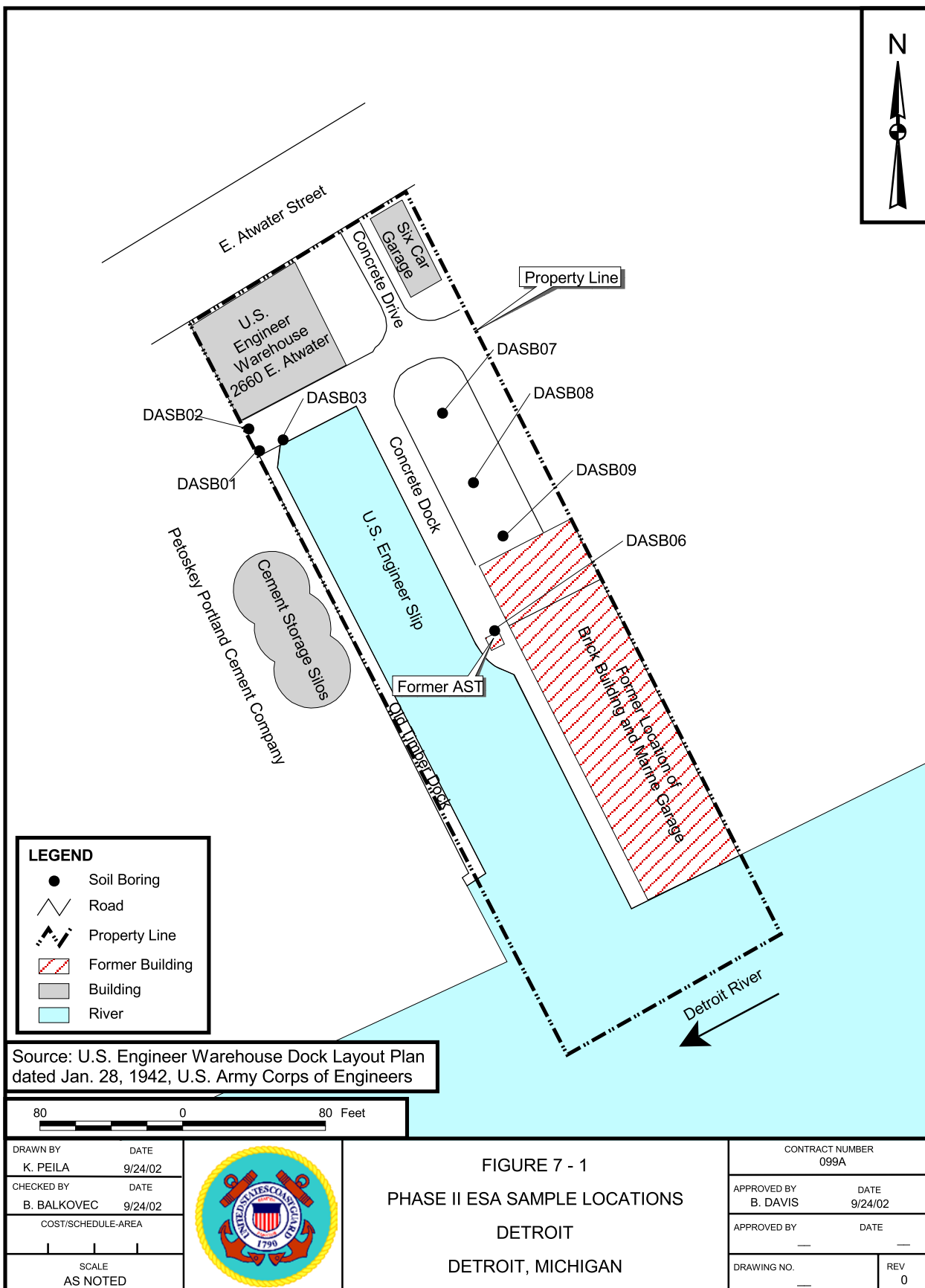
TCLP - Toxicity Characteristic Leaching Procedure

DA - Detroit Atwater

SB - Soil Boring

FD - Field Duplicate

IDW - Investigation Derived Waste



8.0 SAMPLING RESULTS

This section presents the sampling results conducted as part of the Phase II ESA and summarizes the nature of the contamination in the subsurface soil to characterize the three areas of potential environmental concern (the AST, oil and gas storage, and filled-in slip areas) as potential hazards or liability. Figure 8-1 shows the subsurface soil sample locations and the parameter and concentrations that exceed the Michigan Department of Environmental Quality (MDEQ) Part 201 Generic Cleanup Criteria and Screening Levels (criteria). Tables 8-1 and 8-2 summarize the soil sample results.

8.1 ABOVEGROUND STORAGE TANK AREA

Only one of the three planned soil samples was collected in this area. No BTEX or MTBE were detected in the soil near the AST area based on the one soil sample obtained in the field investigation. Lead was identified at a low concentration (10.7 mg/kg), well below the MDEQ residential direct contact soil cleanup criteria and screening concentration (400 mg/kg) in the soil sample obtained in the area of the AST.

8.2 OIL AND GAS STORAGE AREA

No BTEX or MTBE were detected in the soil near the oil and gas storage area based on the three soil samples obtained in the field investigation. Several PAHs were detected in each soil sample, however the concentrations of PAHs were less than the Michigan Residential Direct Contact or the soil to groundwater criteria.

Lead was identified at low concentrations (9.1 and 91.1 mg/kg), well below the MDEQ residential direct contact soil cleanup criteria and screening concentration (400 mg/kg) in two of the soil samples obtained in this area. The highest lead concentration was 454 mg/kg and was observed in the surface soil sample collected from boring DASB03, the soil sample collected in the southeast corner of the oil and gas storage area. The average lead concentration for this area is 184.7 mg/kg, well below the MDEQ residential direct contact soil cleanup criteria and screening concentration.

The location of this property is in an area that the land use is zoned as commercial and industrial. The highest lead result from the soil analysis was compared to the Michigan Industrial Direct Contact criteria and showed that the one soil sample (DASB03) was below the criteria for lead (454 mg/kg compared to the criteria of 900 mg/kg).

8.3 FILLED-IN SLIP AREA

Two VOCs, acetone and 2-butanone, were detected in one of the soil samples collected from the filled-in slip area. The concentrations of these VOCs were well below the MDEQ residential direct contact soil cleanup criteria and screening concentration. The SVOCs that were detected consisted of the chemicals that are listed in the PAH fraction. The concentrations of these PAHs were well below the MDEQ residential direct contact soil cleanup criteria and screening concentration, except for benzo(a)pyrene. Benzo(a)pyrene exceeded the MDEQ residential direct contact soil cleanup criteria and screening concentration in one of the three samples. The benzo(a)pyrene concentration of 4510 ug/kg exceeded the MDEQ criteria (2000 ug/kg) in the northern-most soil sample. The average benzo(a)pyrene concentration for the three soil samples in this area was 1938 ug/kg, below the MDEQ residential direct contact soil cleanup criteria and screening concentration. No pesticides or PCBs were detected in the soil from the filled-in slip area based on the three soil samples obtained in the field investigation.

The eight RCRA metals were detected in the soil samples collected in the filled-in slip area. Arsenic, lead, and selenium were detected at concentrations that exceeded the MDEQ residential direct contact soil cleanup criteria and screening concentration or soil to groundwater criteria. The arsenic concentrations (10.2 to 23.9 mg/kg) in the three samples exceeded the most stringent criteria, the MDEQ Residential Direct Contact criteria (7.6 mg/kg). The lead concentrations (338 to 1070 mg/kg with an average of 603 mg/kg) in two of the three samples exceeded the most stringent criteria, the MDEQ Residential Direct Contact criteria (400 mg/kg). The selenium concentrations (1.8 to 8.7 mg/kg) in only one of the three samples exceeded the most stringent criteria, the MDEQ soil to groundwater criteria (8 mg/kg). These metals are common elements that are found in the soil in the United States. The concentration of arsenic was within the concentration range for soil in the United States as published by the United States Environmental Protection Agency. The concentration of lead and selenium were slightly greater than the concentration range for soil in the United States as published by the United States Environmental Protection Agency.

The location of this property is in an area that the land use is zoned as commercial and industrial. The results from the soil analysis were compared to the Michigan Industrial Direct Contact criteria and showed that one soil sample (DASB07) exceeded the criteria for lead (1070 mg/kg compared to the criteria of 900 mg/kg). The average lead concentration for the filled-in slip area was 603 mg/kg that is below the Michigan Industrial Direct Contact criteria.

TABLE 8-1

**FREQUENCY OF DETECTION IN SOIL
USCG DETROIT ATWATER
DETROIT, MICHIGAN**

PARAMETER	FREQUENCY OF DETECTION	RANGE OF DETECTIONS	RANGE OF NON-DETECTS	SAMPLE CONTAINING MAXIMUM CONCENTRATION	AVERAGE OF ALL POSITIVE CONCENTRATIONS	MICHIGAN DEFAULT BACKGROUND LEVELS	MICHIGAN RESIDENTIAL DIRECT CONTACT SOIL	MICHIGAN INDUSTRIAL DIRECT CONTACT SOIL	MICHIGAN SOIL TO GROUNDWATER	REGION 9 RESIDENTIAL SOIL
Volatile Organics (ug/kg)										
2-BUTANONE	1/3	21.1	34 - 2100	DASB080304	535.6	NA	27000000	27000000	260000	7300000
ACETONE	2/3	45.6 - 92.9	2500 - 4100	DASB080304	69.3	NA	23000000	110000000	15000	1600000
Semivolatile Organics (ug/kg)										
2,4-DIMETHYLPHENOL	1/3	45.6	200 - 210	DASB070304	45.6	NA	11000000	56000000	7400	1200000
2-METHYLNAPHTHALENE	2/6	75.6 - 488	200 - 210	DASB070304	281.8	NA	8100000	40000000	57000	56000
3&4-METHYLPHENOL	1/3	45.2	200 - 210	DASB070304	45.2	NA	11000000	56000000	7400	NA
ACENAPHTHENE	4/6	42.7 - 1350	200	DASB070304	384.1	NA	41000000	200000000	300000	3700000
ACENAPHTHYLENE	4/6	69.6 - 480	200 - 210	DASB030406	230.3	NA	1600000	8000000	5900	3700000
ANTHRACENE	5/6	61.1 - 2370	200	DASB070304	639.6	NA	230000000	1000000000	41000	22000000
BENZO(A)ANTHRACENE	6/6	45.1 - 4810	200	DASB070304	1212.2	NA	20000	100000	NA	620
BENZO(A)PYRENE	6/6	50.5 - 4510	200	DASB070304	1192.3	NA	2000	10000	NA	62
BENZO(B)FLUORANTHENE	6/6	63.6 - 5030	200	DASB070304	1264.9	NA	20000	100000	NA	620
BENZO(G,H,I)PERYLENE	5/6	85.8 - 4080	200	DASB070304	1217.2	NA	2500000	9100000	NA	23000000
BENZO(K)FLUORANTHENE	5/6	58 - 1740	200	DASB070304	516.4	NA	200000	1000000	NA	6200
CARBAZOLE	3/3	54.5 - 645	0	DASB070304	263.4	NA	530000	3700000	9400	24000
CHRYSENE	6/6	46.3 - 4620	200	DASB070304	1188.2	NA	2000000	10000000	NA	62000
DIBENZO(A,H)ANTHRACENE	4/6	92.5 - 451	200 - 210	DASB070304	219.1	NA	2000	10000	NA	62
DIBENZOFURAN	2/3	75.2 - 647	200	DASB070304	361.1	NA	NA	NA	NA	290000
FLUORANTHENE	6/6	69.8 - 11100	200	DASB070304	2612.6	NA	46000000	180000000	730000	2300000
FLUORENE	3/6	59 - 1660	200 - 210	DASB070304	615.7	NA	27000000	130000000	390000	2600000
INDENO(1,2,3-CD)PYRENE	4/6	382 - 3610	200 - 210	DASB070304	1363.8	NA	20000	100000	NA	620
NAPHTHALENE	3/6	44.2 - 1860	200 - 210	DASB070304	649.8	NA	16000000	80000000	35000	56000
PHENANTHRENE	5/6	209 - 8430	200	DASB070304	2157.6	NA	1600000	8000000	56000	2300000
PYRENE	5/6	287 - 10800	200	DASB070304	2885.4	NA	29000000	110000000	480000	2300000
Inorganics (mg/kg)										
ARSENIC	3/3	10.2 - 23.9	0	DASB090304	15.9	5.8	7.6	61	23	0.39
BARIUM	3/3	122 - 619	0	DASB080304-D	338.7	75	37000	250000	1300	5400
CADMIUM	3/3	0.3 - 0.35	0	DASB070304	0.32	1.2	550	4100	6	37
CHROMIUM	3/3	7.3 - 10.4	0	DASB090304	8.7	18	790000	1000000	1000000	100000
LEAD	7/7	9.1 - 1070	0	DASB070304	358.8	21	400	900	700	400
MERCURY	3/3	0.35 - 1.1	0	DASB090304	0.74	0.13	160	1100	1.7	23
SELENIUM	3/3	1.8 - 8.7	0	DASB080304-D	3.9	0.41	2600	18000	4	390
SILVER	3/3	0.07 - 0.24	0	DASB080304-D	0.17	1	2500	17000	4.5	390

Range of detections is highlighted if the maximum concentration is greater than the MI Default Background Level (inorganics only) and exceeds the Michigan Residential Direct Contact or the Soil to Groundwater Criteria

The highlighted criteria indicates that at least 1 sample exceeded the criteria

Michigan Industrial Direct Contact and US EPA Region 9 Preliminary Remediation Goals for Residential Soil are included in this table for information only

TABLE 8-2

SUMMARY OF POSITIVE DETECTIONS IN SOIL
USCG DETROIT ATWATER
DETROIT, MICHIGAN

	OIL AND GAS STORAGE AREA				AST AREA	FILLED-IN SLIP AREA				MICHIGAN DEFAULT BACKGROUND LEVELS	MICHIGAN RESIDENTIAL DIRECT CONTACT SOIL	MICHIGAN INDUSTRIAL DIRECT CONTACT SOIL	MICHIGAN SOIL TO GROUNDWATER	REGION 9 RESIDENTIAL SOIL
LOCATION	DASB01	DASB01	DASB02	DASB03	DASB06	DASB07	DASB08	DASB08	DASB09					
TOP DEPTH	4	4	4.5	1	8.5	1	2	2	1					
BOTTOM DEPTH	5	5	5.5	3	9	2	3	3	2					
		Duplicate						Duplicate						
Volatile Organics (ug/kg)														
2-BUTANONE	NT	NT	NT	NT	NT	34 U	21.1 J	2100 U	1300 U	NA	27000000	27000000	260000	7300000
ACETONE	NT	NT	NT	NT	NT	45.6 J	92.9 J	4100 U	2500 U	NA	23000000	110000000	15000	1600000
Semivolatile Organics (ug/kg)														
2,4-DIMETHYLPHENOL					NT	45.6 J	210 U	NT	200 U	NA	11000000	56000000	7400	1200000
2-METHYLNAPHTHALENE	200 U	200 U	210 U	200 U	NT	488	75.6 J	NT	200 U	NA	8100000	40000000	57000	56000
3&4-METHYLPHENOL	NT	NT	NT	NT	NT	45.2 J	210 U	NT	200 U	NA	11000000	56000000	7400	NA
ACENAPHTHENE	200 U	200 U	42.7 J	200 U	NT	1350	97.2 J	NT	46.6 J	NA	41000000	200000000	300000	3700000
ACENAPHTHYLENE	200 U	200 U	210 U	480	NT	298	73.5 J	NT	69.6 J	NA	1600000	8000000	5900	3700000
ANTHRACENE	200 U	200 U	61.1 J	261	NT	2370	340	NT	166 J	NA	230000000	1000000000	41000	22000000
BENZO(A)ANTHRACENE	200 U	45.1 J	149 J	812	NT	4810	807	NT	650	NA	20000	100000	NA	620
BENZO(A)PYRENE	200 U	50.5 J	128 J	1160	NT	4510	711	NT	594	NA	2000	10000	NA	62
BENZO(B)FLUORANTHENE	200 U	63.6 J	154 J	865	NT	5030	804	NT	673	NA	20000	100000	NA	620
BENZO(G,H,I)PERYLENE	200 U	200 U	85.8 J	1180	NT	4080	401	NT	339	NA	2500000	9100000	NA	2300000
BENZO(K)FLUORANTHENE	200 U	200 U	58 J	308	NT	1740	267	NT	209	NA	200000	1000000	NA	6200
CARBAZOLE	NT	NT	NT	NT	NT	645	90.6 J	NT	54.5 J	NA	530000	3700000	9400	24000
CHRYSENE	200 U	46.3 J	146 J	898	NT	4620	753	NT	666	NA	2000000	10000000	NA	62000
DIBENZO(A,H)ANTHRACENE	200 U	200 U	210 U	233	NT	451	99.7 J	NT	92.5 J	NA	2000	10000	NA	62
DIBENZOFURAN	NT	NT	NT	NT	NT	647	75.2 J	NT	200 U	NA	NA	NA	NA	290000
FLUORANTHENE	200 U	69.8 J	321	875	NT	11100	1940	NT	1370	NA	46000000	180000000	730000	2300000
FLUORENE	200 U	200 U	210 U	200 U	NT	1660	128 J	NT	59 J	NA	27000000	130000000	390000	2600000
INDENO(1,2,3-CD)PYRENE	200 U	200 U	210 U	989	NT	3610	474	NT	382	NA	20000	100000	NA	620
NAPHTHALENE	200 U	200 U	210 U	44.2 J	NT	1860	45.1 J	NT	200 U	NA	16000000	80000000	35000	56000
PHENANTHRENE	200 U	200 U	209 J	356	NT	8430	1220	NT	573	NA	1600000	8000000	56000	2300000
PYRENE	200 U	200 U	287	1360	NT	10800	1150	NT	830	NA	29000000	110000000	480000	2300000
Inorganics (mg/kg)														
ARSENIC	NT	NT	NT	NT	NT	10.2	13.7	13.2	23.9	5.8	7.6	61	23	0.39
BARIUM	NT	NT	NT	NT	NT	459	251	619	122	75	37000	250000	1300	5400
CADMIUM	NT	NT	NT	NT	NT	0.35	0.32	0.31	0.30	1.2	550	4100	6	37
CHROMIUM	NT	NT	NT	NT	NT	7.3	8.7	8.2	10.4	18	790000	1000000	1000000	100000
LEAD	9.1	NT	91.1	454	10.7	1070	401	677	338	21	400	900	700	400
MERCURY	NT	NT	NT	NT	NT	0.45	0.98	0.35	1.1	0.13	160	1100	1.7	23
SELENIUM	NT	NT	NT	NT	NT	1.8	3.6	8.7	3.8	0.41	2600	18000	4	390
SILVER	NT	NT	NT	NT	NT	0.07	0.21	0.24	0.20	1	2500	17000	4.5	390

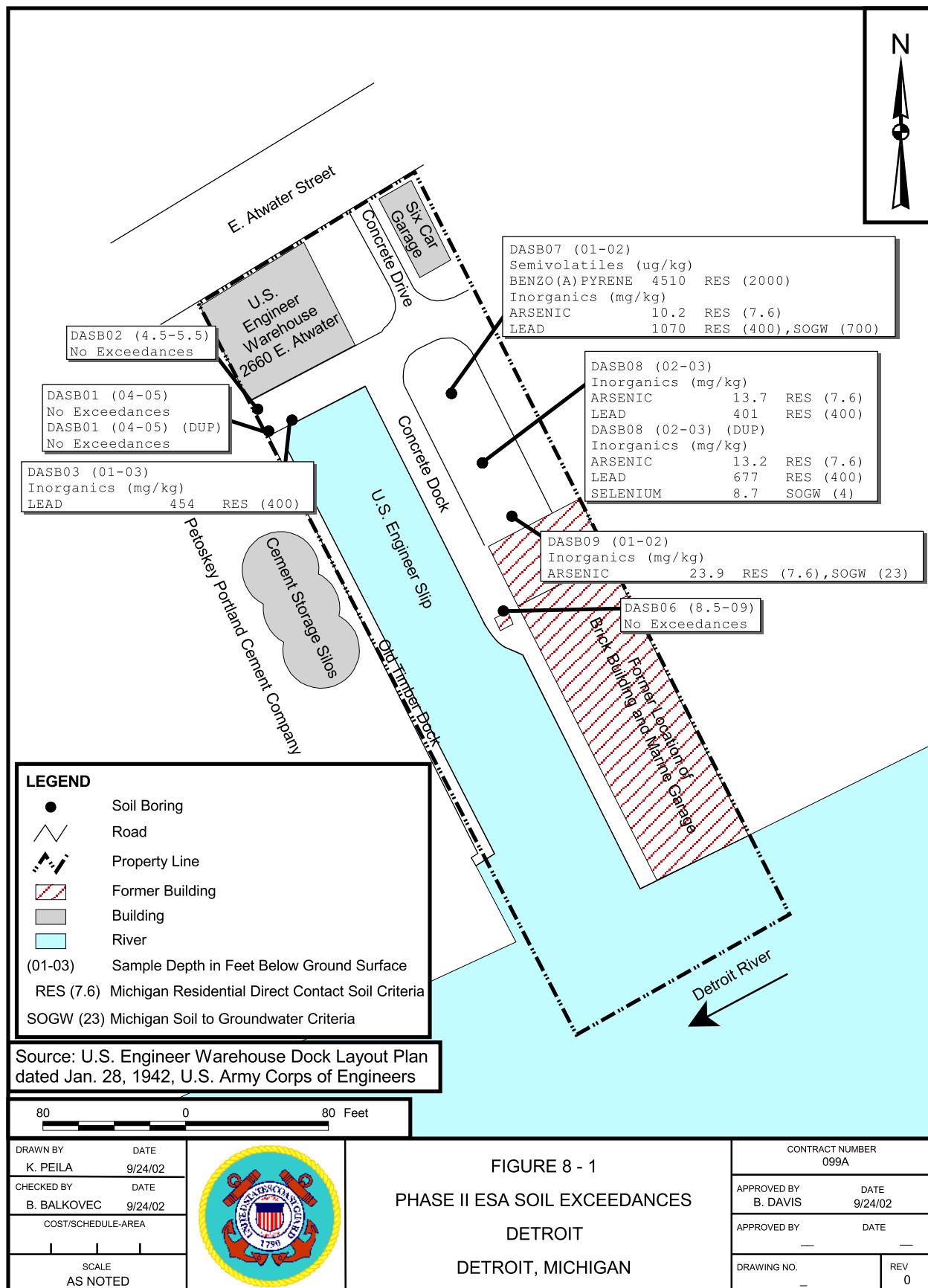
NT - Not Tested

NA - Not Applicable

Sample results are highlighted if the concentration is greater than the Michigan Default Background Level (inorganics only) and exceeds the Michigan Residential Direct Contact or the Soil to Groundwater Criteria

The highlighted criteria indicates that at least 1 sample exceeded the criteria

Michigan Industrial Direct Contact and US EPA Region 9 Preliminary Remediation Goals for Residential Soil are included in this table for information only



9.0 PHASE II CONCLUSIONS AND RECOMMENDATIONS

Based on the Phase II ESA field investigation, the following conclusions and recommendations are presented regarding the subject site.

9.1 CONCLUSIONS

- One soil sample was collected in the AST area. The analysis of the soil sample did not detect BTEX or MTBE. Lead was detected in the sample at a concentration of 10.7 mg/kg, well below the MDEQ residential direct contact soil cleanup criteria and screening concentration.
- Three soil samples were collected in the former oil and gas storage area. The analysis of the soil samples did not detect BTEX or MTBE. Several PAHs were detected in each soil sample, however the concentrations of PAHs were less than the MDEQ residential criteria. Lead was also detected in the soil samples, with one sample exceeding the MDEQ residential criteria but was less than the MDEQ industrial criteria. The average lead concentration for the three samples from this area was 184.7 mg/kg, well below the MDEQ residential criteria (400 mg/kg).
- Three soil samples were collected in the filled-in slip area. The analysis of the soil samples for VOCs, SVOCs, pesticides, PCBs, and RCRA metals identified benzo(a)pyrene, arsenic, lead, and selenium concentrations in the soil that exceeded the MDEQ criteria. However, the average benzo(a)pyrene concentration for the three samples from this area was 1938 µg/kg, below the MDEQ criteria (2000 µg/kg). Three RCRA metals (arsenic, lead, and selenium) were detected in the soil samples that exceeded the MDEQ criteria. The concentration of arsenic was within the concentration range for soil in the United States and the concentration of lead and selenium were slightly greater than the concentration range for soil in the United States as published by the United States Environmental Protection Agency.
- The location of this property is in an area that the land use is zoned as commercial and industrial. The results from the soil analysis were compared to the Michigan Industrial Direct Contact criteria and showed that one soil sample (DASB07) exceeded the criteria for lead (1070 mg/kg compared to the criteria of 900 mg/kg). The average lead concentration is below the Michigan Industrial Direct Contact criteria.
- In summary, this Phase II ESA field investigation revealed the three areas of potential environmental concern identified in the Phase I ESA met most of the MDEQ criteria for the soil samples that were collected. No areas of significant environmental concern require rectification prior to transfer of the property.

9.2 RECOMMENDATIONS

TtNUS has no recommendations for further study at the subject property at this time.

REFERENCES

Civilian Federal Agency Task Force, 1998. Guide on Evaluating Environmental Liability for Property Transfers.

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Geraghty & Miller, Inc., 1997. Letter to MDEQ related to the pipeline break. August 18.

Michigan Department of Environmental Quality, 2000. Part 201 Generic Cleanup Criteria and Screening Levels, Developed under the Authority of the Natural Resources and Environmental Protection Act, 1994 Pa 451, as Amended, June 7.

USCG, 1997. Asbestos and Lead Sample Results, May 2.

APPENDIX A

SITE PHOTOGRAPHS



USCG-Detroit Atwater site looking North (Away from river). The former AST and fueling pad can be seen in foreground.



Western half of USCG-Detroit Atwater site and the property which borders to the west.



Eastern half of site and the property which borders to the east.



Inside of main building showing materials that are currently stored in the building.



Inside of building showing paint peeling on ceiling. Insulated pipes were in good condition.



Inside of building showing wood block floor and minimal staining. Most staining is due to water and flooding which occurred in March 1997.



Second floor of building used for storage. Formerly used as office space.



Outside of garage. Building is currently and historically was used as storage. Mainly building materials and miscellaneous materials. No chemicals or hazardous waste stored inside.



Outside of main building. Structure is in good condition and is always locked. Currently used for storage.



USCG-Detroit Atwater site looking south towards Detroit River.



Western half of site showing miscellaneous debris stored on site and neighboring aggregate silos.



Inside of garage showing materials that are stored inside. Building is in decent condition.



Looking North at locked gate. Gate is always locked preventing access without permission.



Atwater street looking west.



Atwater Street looking East.



Looking Southeast at the parking lot toward Detroit River.



Looking Southeast at the parking lot, former brick building and boathouse area, slip just to the left side of the white truck, the Detroit River and Windsor City, Canada in the rear.



Drilling in the former AST area at location DASB06.



Looking directly to the South from the former brick building and boathouse area. The area is now an uncovered boat slip.



Looking Southwest from the parking lot at the former AST area. Photograph also includes, boat slip on the right side of the photo, concrete dock in between the two boat slips. The former boathouse was located on the left side of the photograph and is now an uncovered boat slip.



Photograph depicts the concrete patching of the borehole.



Photograph depicts the boring location at former oil and gas storage area.



Photograph depicts the 5-gallon bucket used to store the Investigation Derived Waste (Soil).

APPENDIX B

MAPS AND PHOTOGRAPHS

TOPOGRAPHIC MAPS

SANBORN MAPS

AERIAL PHOTOGRAPHS



The EDR-Historical Topographic Map Report

**USCG Detroit Atwater Property
2660 E. Atwater St
Detroit, MI 48207**

May 2, 2001

Inquiry Number: 625908-6

The Source For Environmental Risk Management Data

**3530 Post Road
Southport, Connecticut 06490**

Nationwide Customer Service

**Telephone: 1-800-352-0050
Fax: 1-800-231-6802**

Environmental Data Resources, Inc.

Historical Topographic Map Report

Environmental Data Resources, Inc.'s (EDR) Historical Topographic Map Report is designed to assist professionals in evaluating potential liability on a target property, and its surrounding area, resulting from past activities. ASTM E 1527-00, Section 7.3 on Historical Use Information, identifies the prior use requirements for a Phase I environmental site assessment. The ASTM standard requires a review of *reasonably ascertainable standard historical sources*. *Reasonably ascertainable is defined as information that is publicly available, obtainable from a source with reasonable time and cost constraints, and practically reviewable.*

To meet the prior use requirements of ASTM E 1527-00, Section 7.3.2, the following *standard historical sources* may be used: aerial photographs, city directories, fire insurance maps, topographic maps, property tax files, land title records (although these cannot be the sole historical source consulted), building department records, or zoning and use records. ASTM E 1527-00 requires *"All obvious uses of the property shall be identified from the present, back to the property's obvious first developed use, or back to 1940, whichever is earlier. This task requires reviewing only as many of the standard historical sources as are necessary, and that are reasonably ascertainable and likely to be useful."* (ASTM E 1527-00, Section 7.3.2 page 11.)

EDR's Historical Topographic Map Report includes a search of available public and private color historical topographic map collections.

Topographic Maps

A topographic map (topo) is a color coded line-and-symbol representation of natural and selected artificial features plotted to a scale. Topos show the shape, elevation, and development of the terrain in precise detail by using contour lines and color coded symbols. Many features are shown by lines that may be straight, curved, solid, dashed, dotted, or in any combination. The colors of the lines usually indicate similar classes of information. For example, topographic contours (brown); lakes, streams, irrigation ditches, etc. (blue); land grids and important roads (red); secondary roads and trails, railroads, boundaries, etc. (black); and features that have been updated using aerial photography, but not field verified, such as disturbed land areas (e.g., gravel pits) and newly developed water bodies (purple).

For more than a century, the USGS has been creating and revising topographic maps for the entire country at a variety of scales. There are about 60,000 U.S. Geological Survey (USGS) produced topo maps covering the United States. Each map covers a specific quadrangle (quad) defined as a four-sided area bounded by latitude and longitude. Historical topographic maps are a valuable historical resource for documenting the prior use of a property and its surrounding area, and due to their frequent availability can be particularly helpful when other standard historical sources (such as city directories, fire insurance maps, or aerial photographs) are not reasonably ascertainable.

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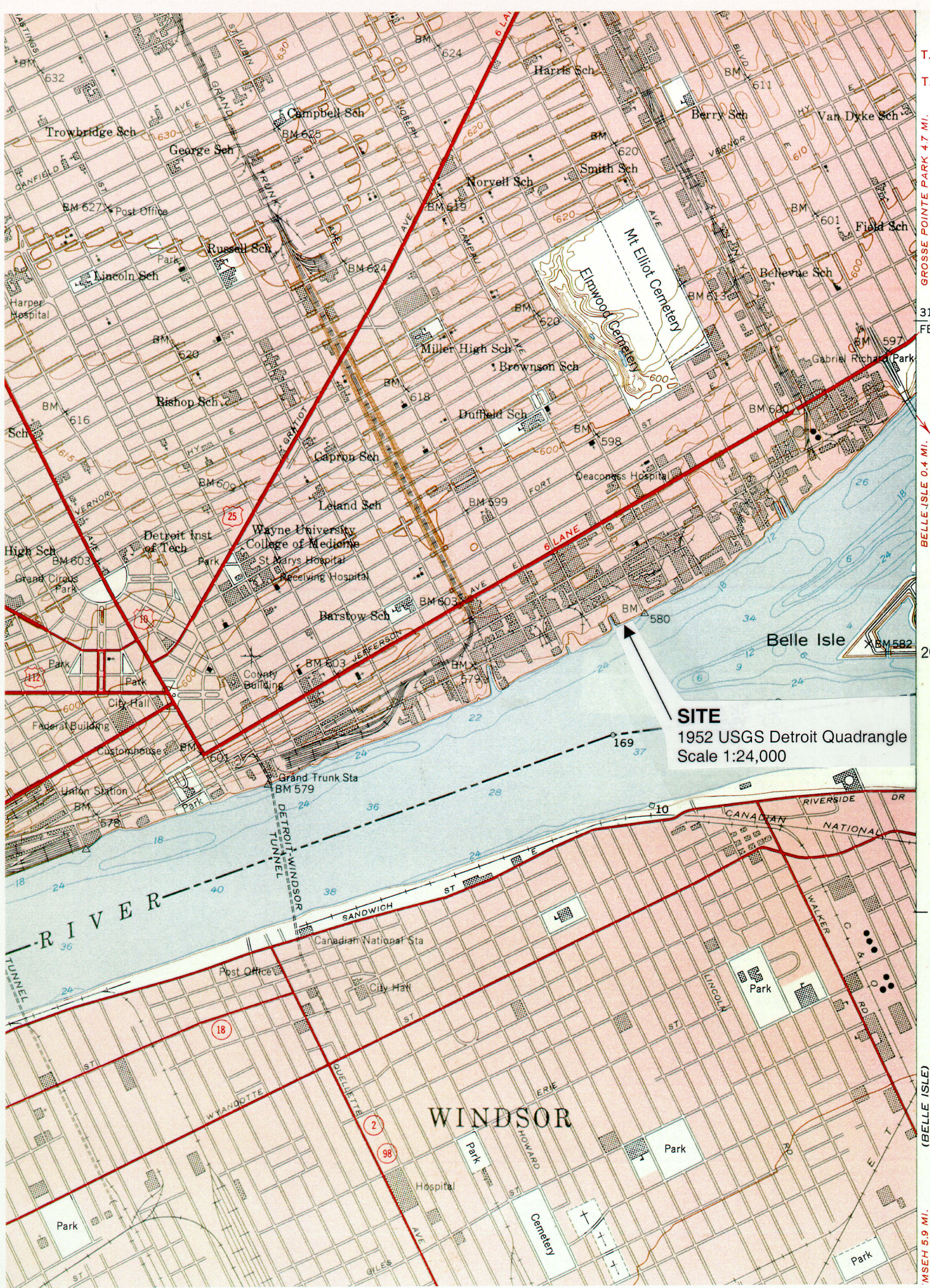
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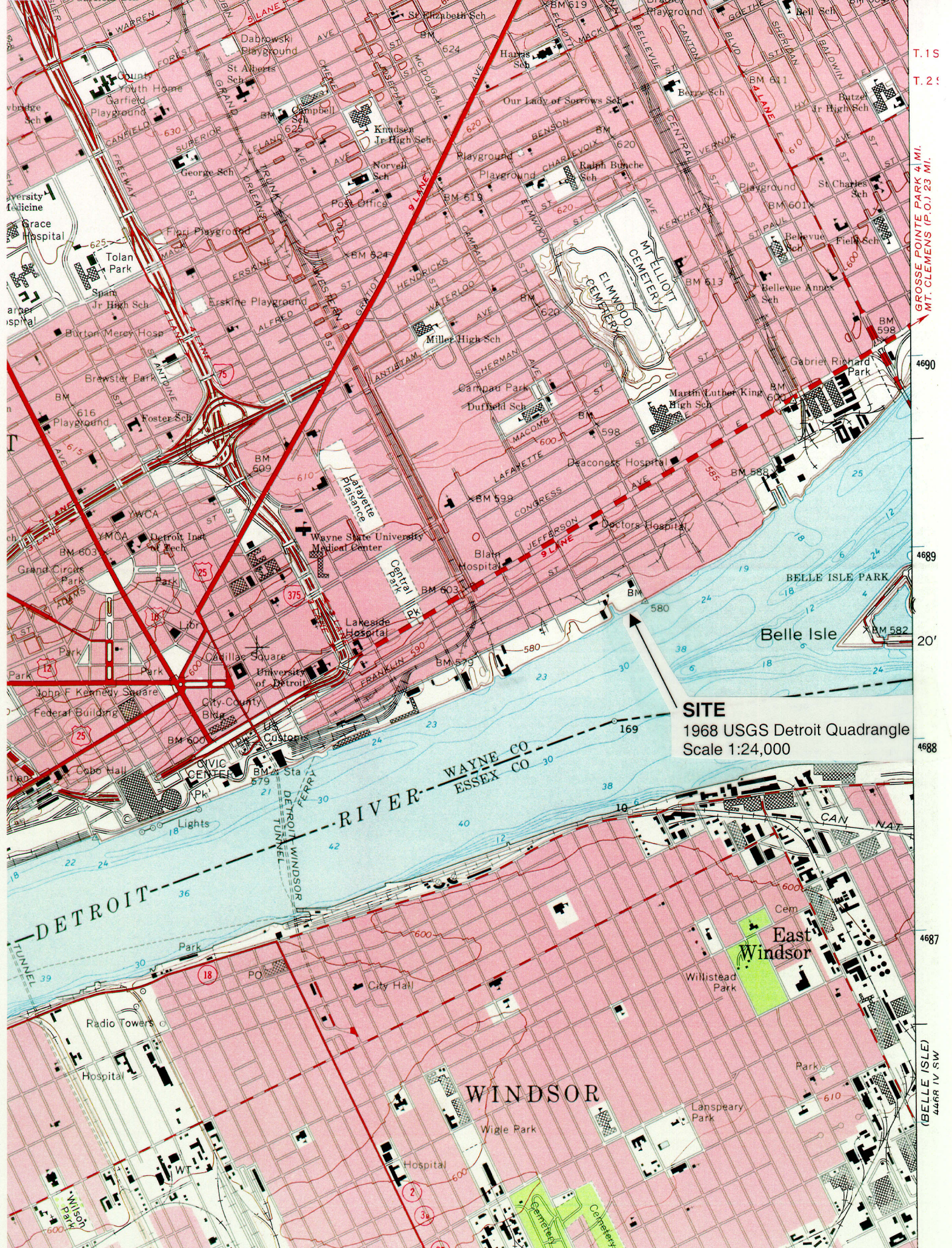
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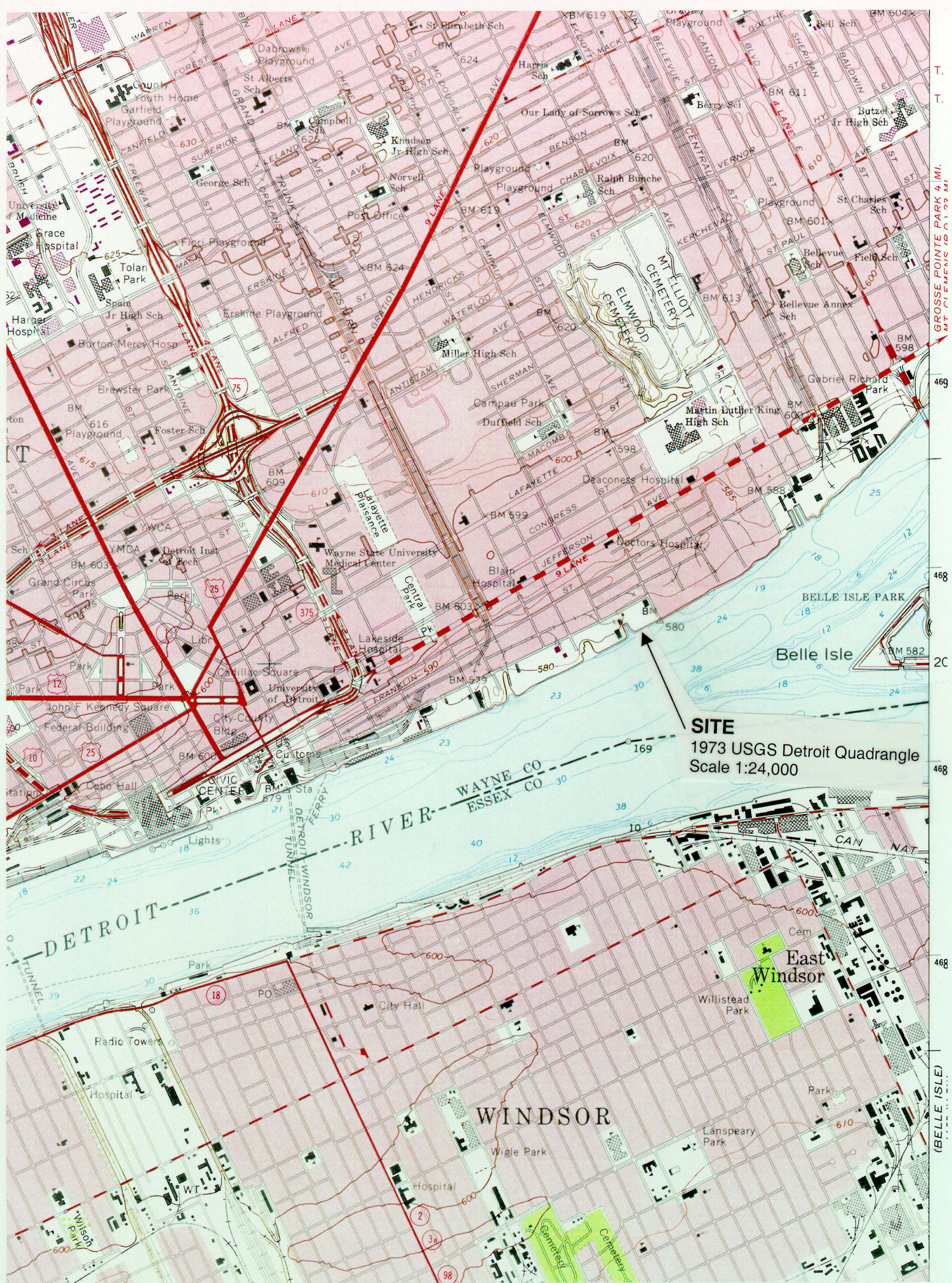




SITE
1968 USGS Detroit Quadrangle
Scale 1:24,000

T. 1 S
T. 2 S
GROSSE POINTE PARK 4 MI.
MT. CLEMENS (P.O.) 23 MI.

(BELLE ISLE)
446R IV SW



SITE
1973 USGS Detroit Quadrangle
Scale 1:24,000

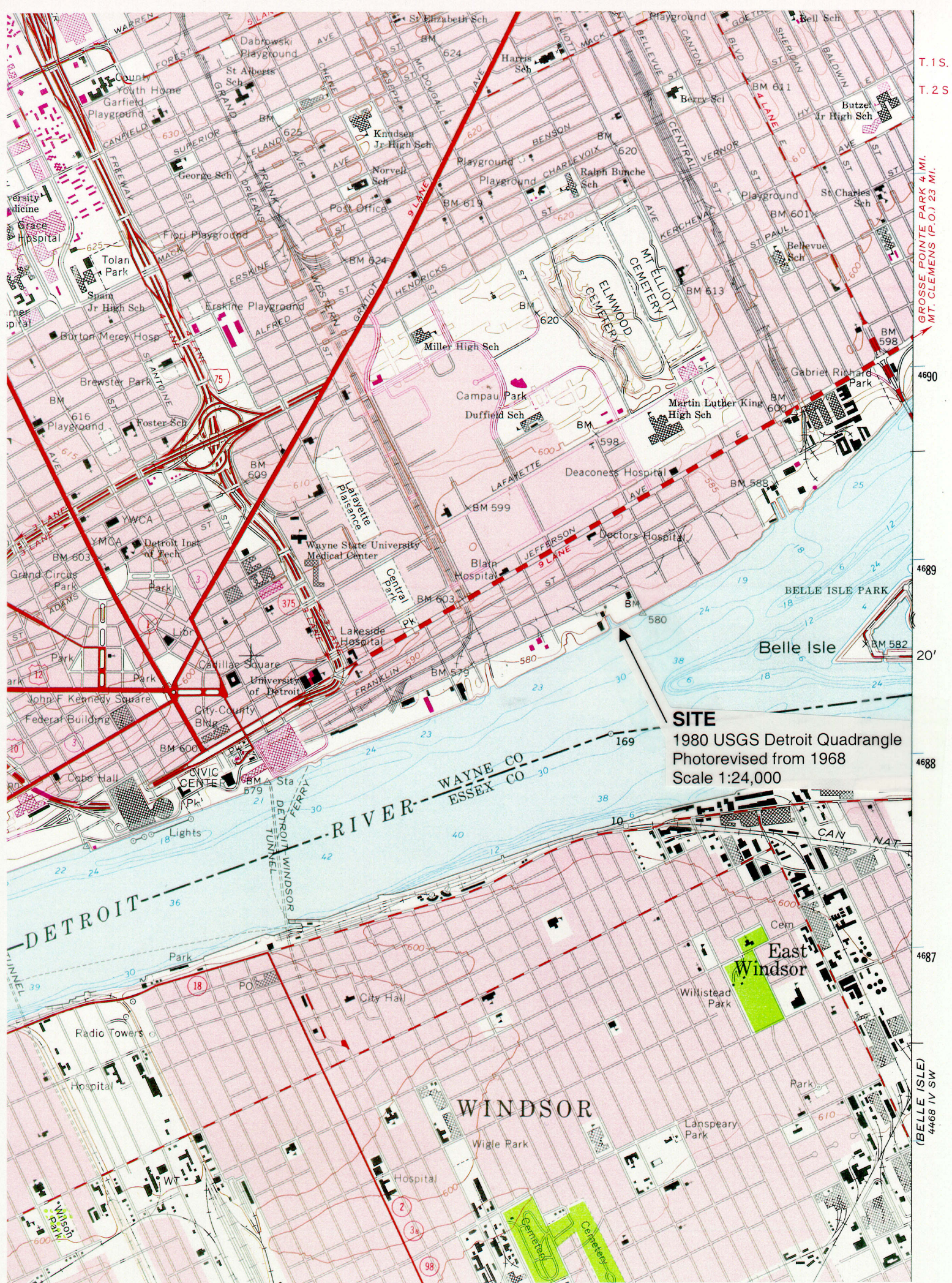
T.
T.
GROSSE POINTE PARK 4 MI.
MT CLEMENS 12 MI. 1.25 MI.

469
468
2C

468

468

(BELLE ISLE)



SITE

1980 USGS Detroit Quadrangle
Photorevised from 1968
Scale 1:24,000

T.1 S.
T.2 S
GROSSE POINTE PARK 4 MI.
MT. CLEMENS (P.O.) 23 MI.

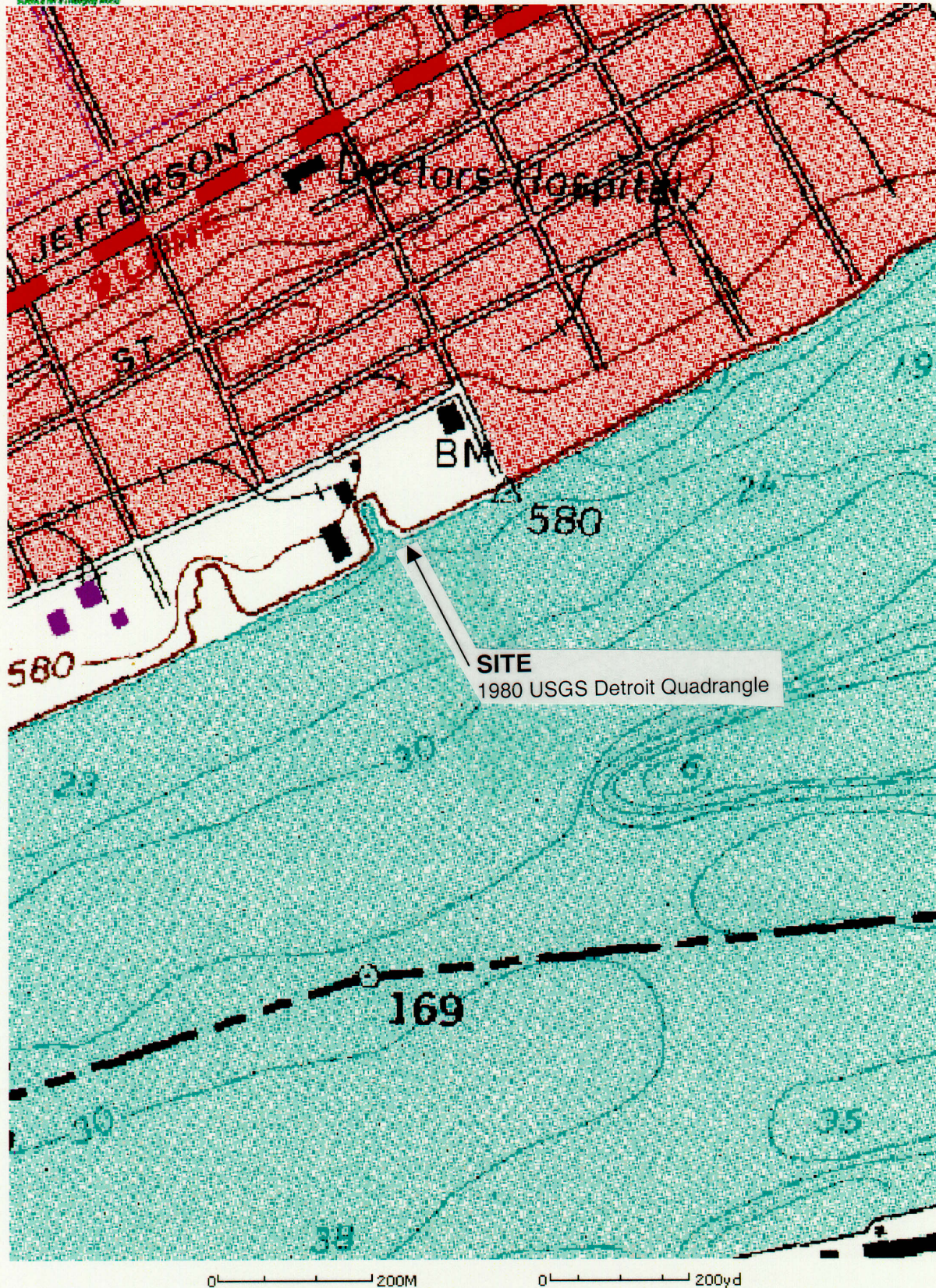
(BELLE ISLE)
4468 IV SW

Microsoft TerraServer

Display Image

USGS Topo Map

Detroit, Michigan, United States 01 Jul 1980



Linking Technology with Tradition"

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Ship to: Robert Davis

Tetra Tech NUS, Inc.

Foster Race N

Pittsburgh, PA 15

Order Date: 10

Inquiry # 95

P.O. # 99a-0

Site Name: USCG Detroit Atwater Property

Address: E. Atwater St

City/State: Detroit, MI 4

Completion Date: 00

131SON

421-700

Cross Streets:

Based on client-supplied information, fire insurance maps for the following years were identified

18 3map	198 1 - map
187 - 1 - map	1991 - 1 - map
192 1 - map	
196 1 - map	
193 1 map	
193 - 1 map	
196 - 1 map	
1977 - 1 map	

Total Maps: 12

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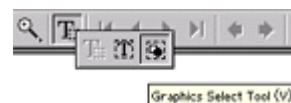
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- Highlight Tools!
- Highlight Select Graphics!
- Draw a box around the area of interest.
- Go to the Menu Bar.
- Highlight Edit!
- Highlight Copy!
- Go to a word processor such as Microsoft Word and paste. Print from the word processor.

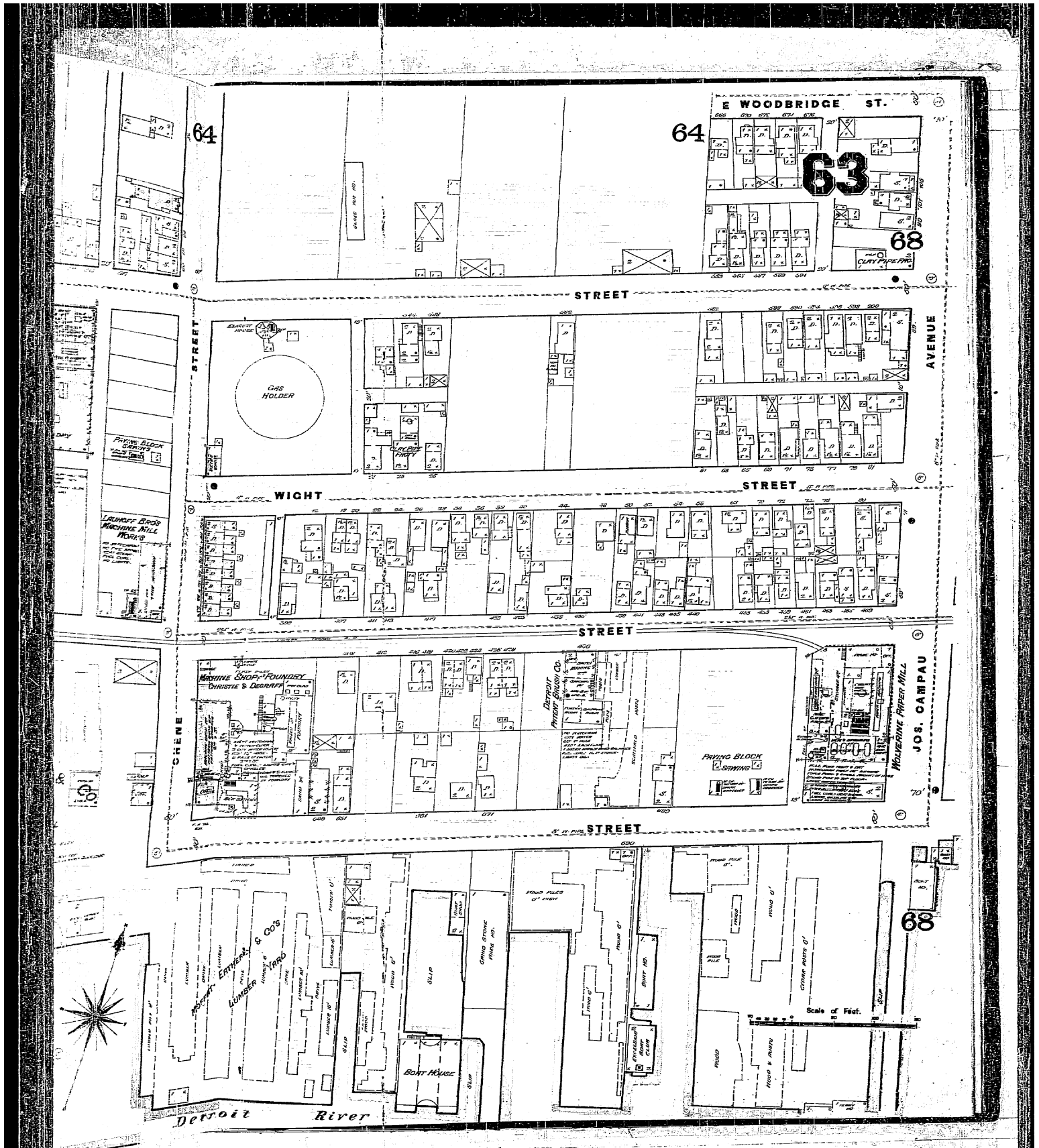
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- Press and hold the T' button.
- Choose the Graphics Select Tool.
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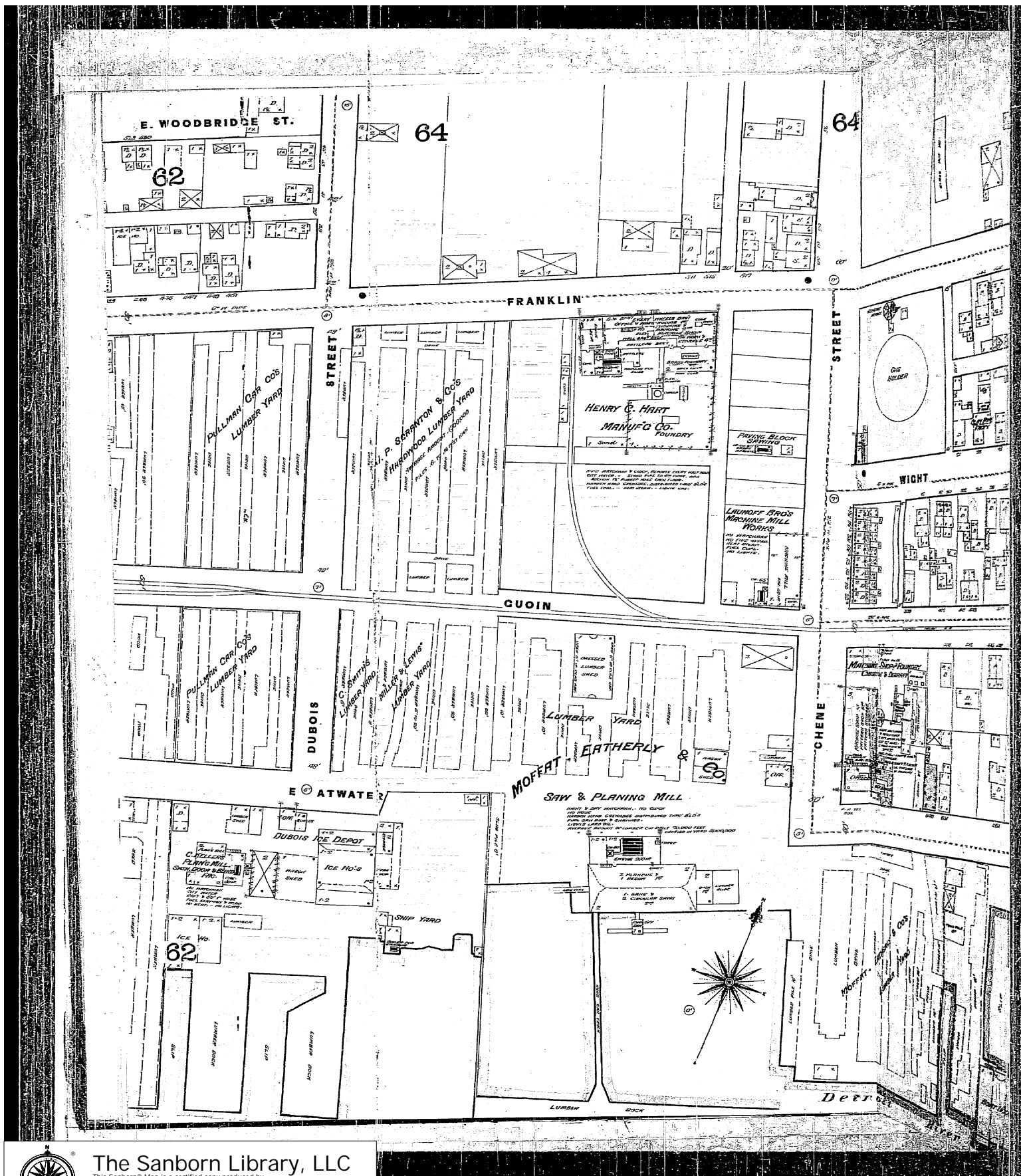


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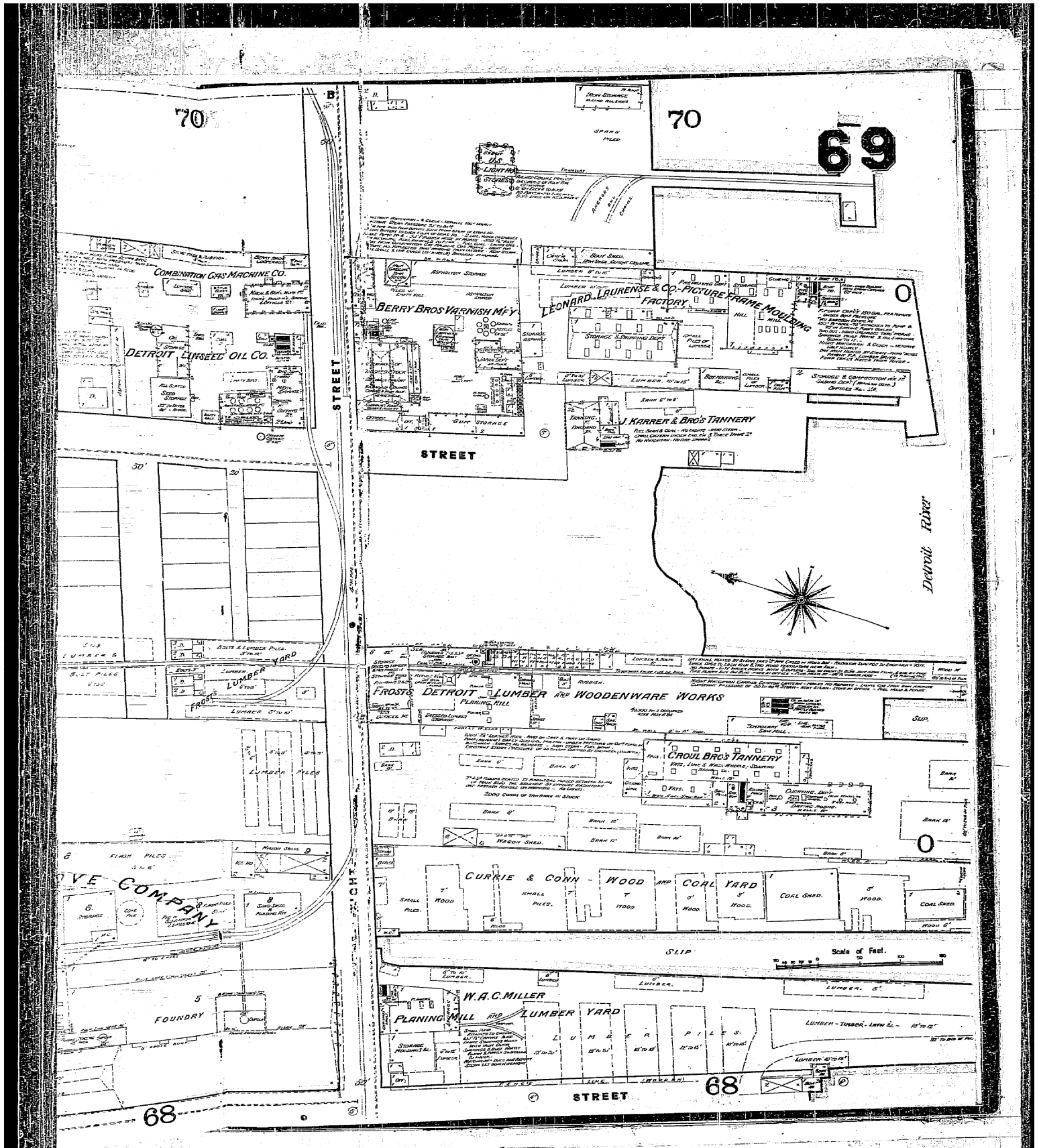


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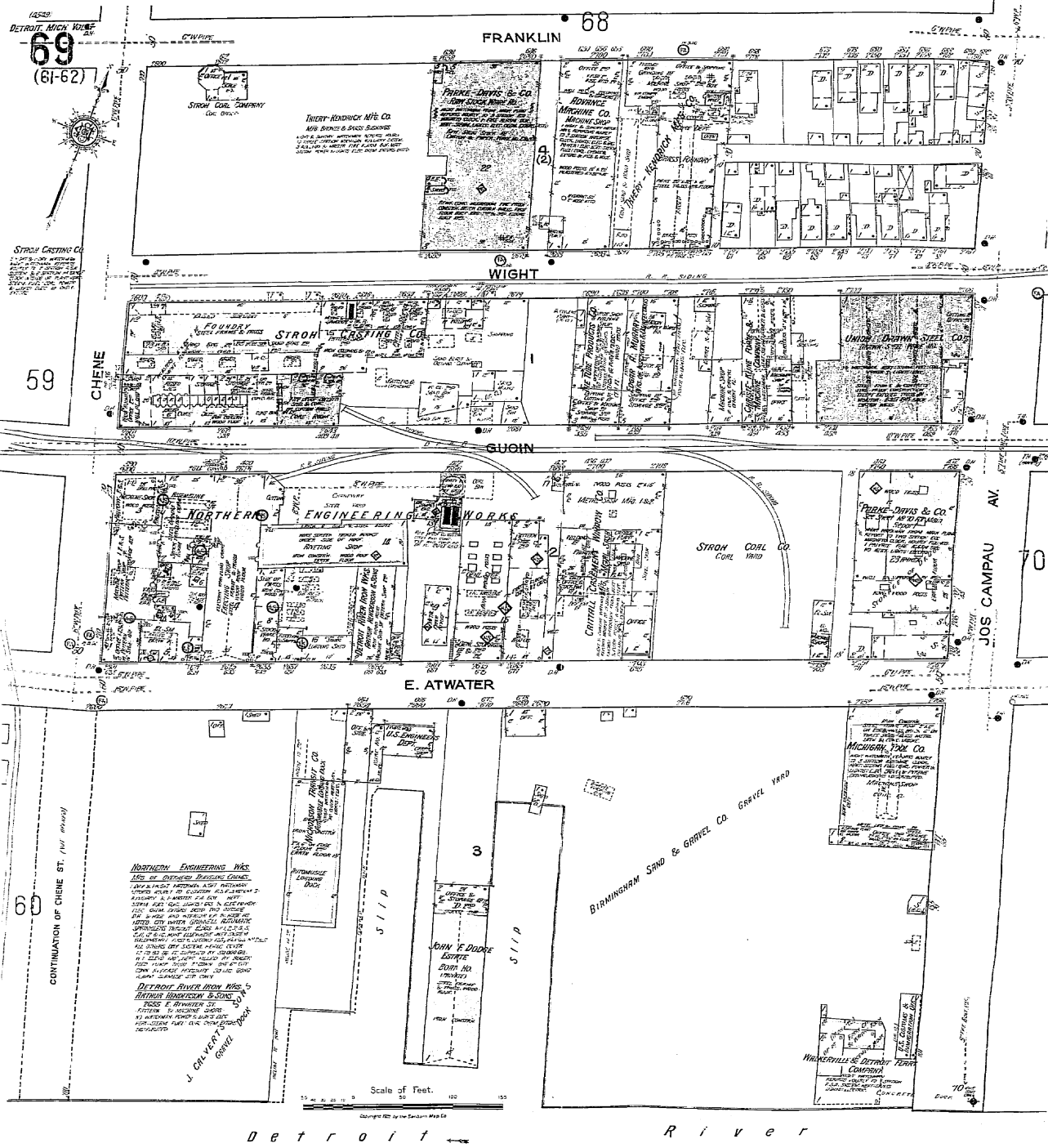


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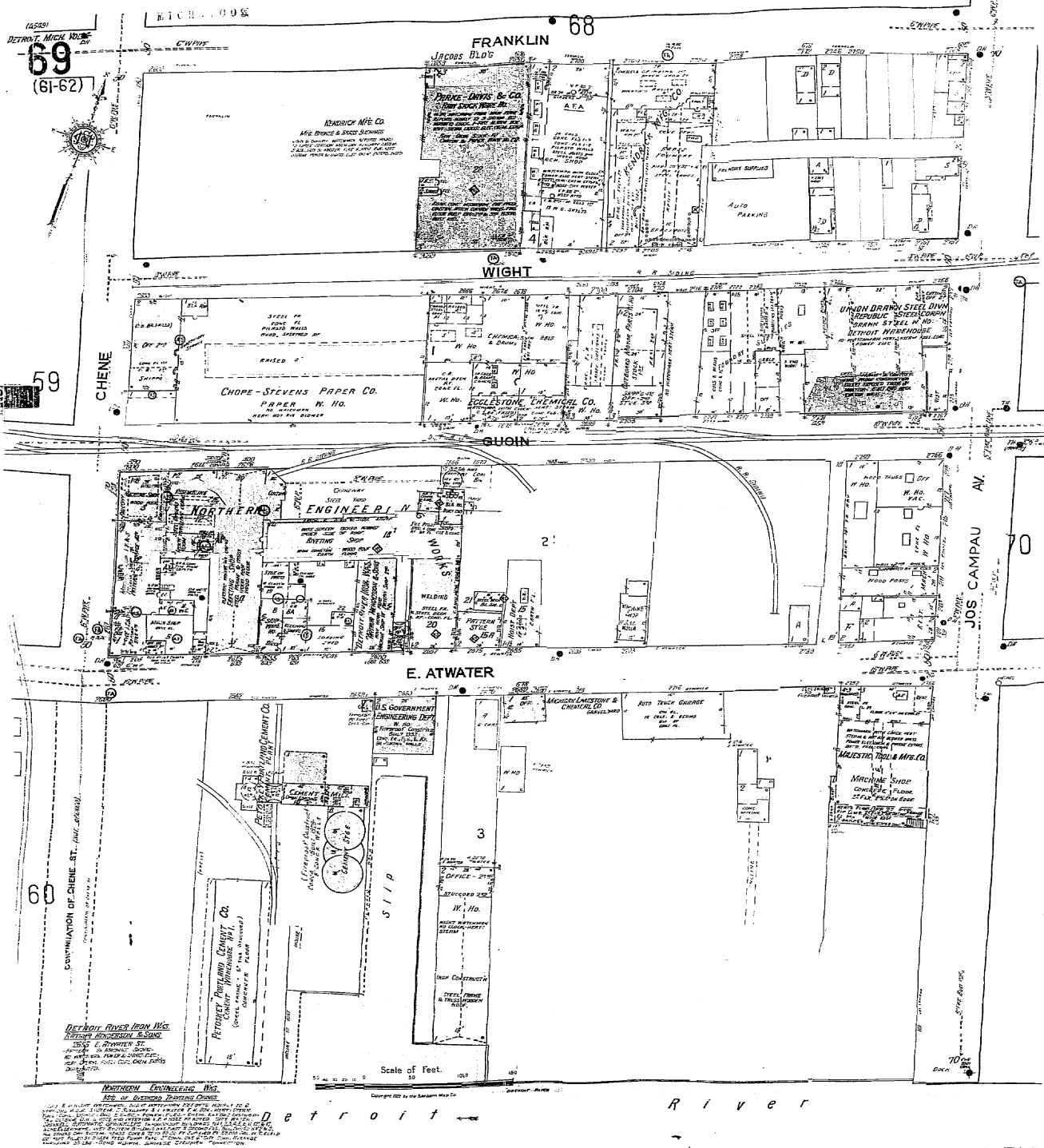


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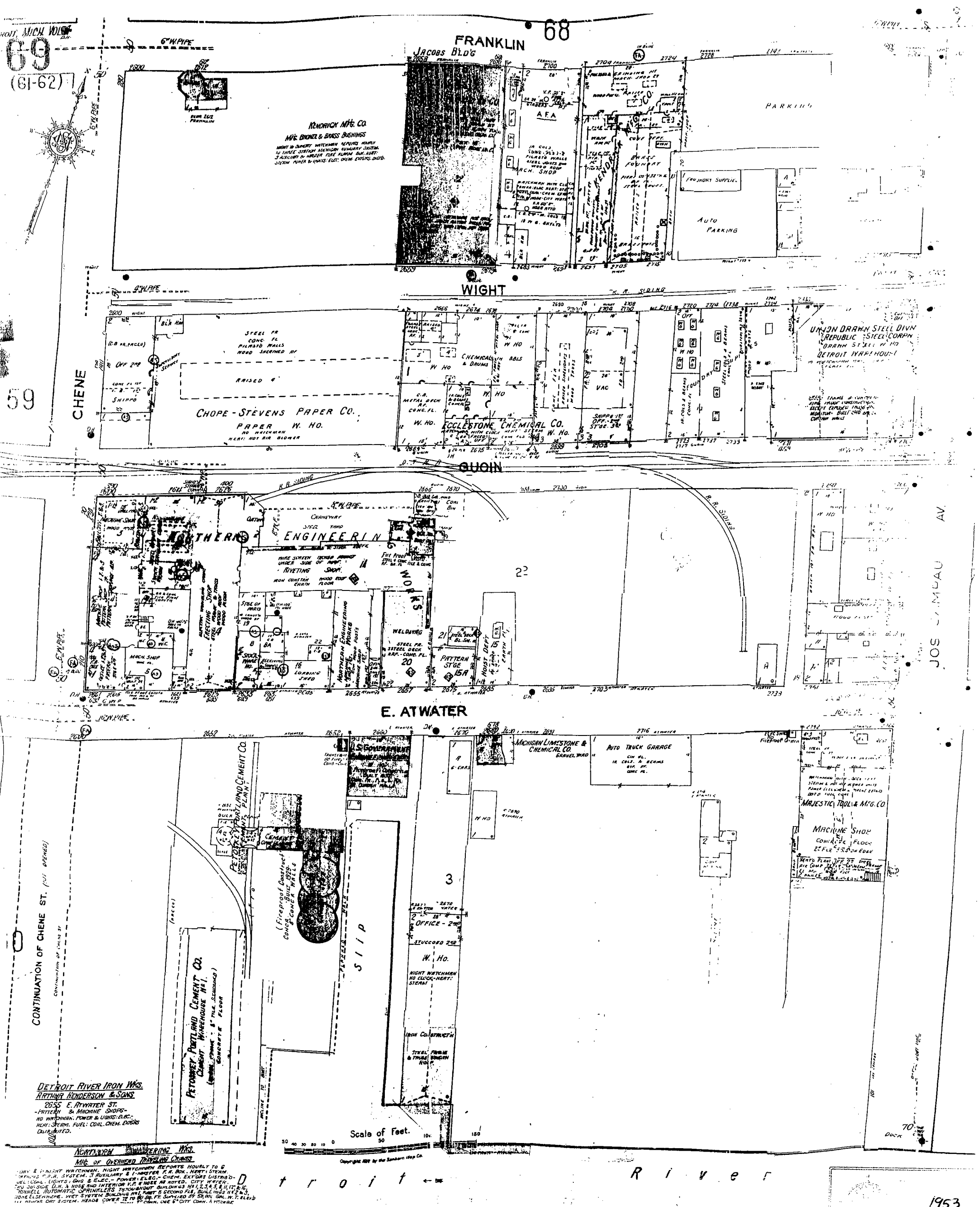


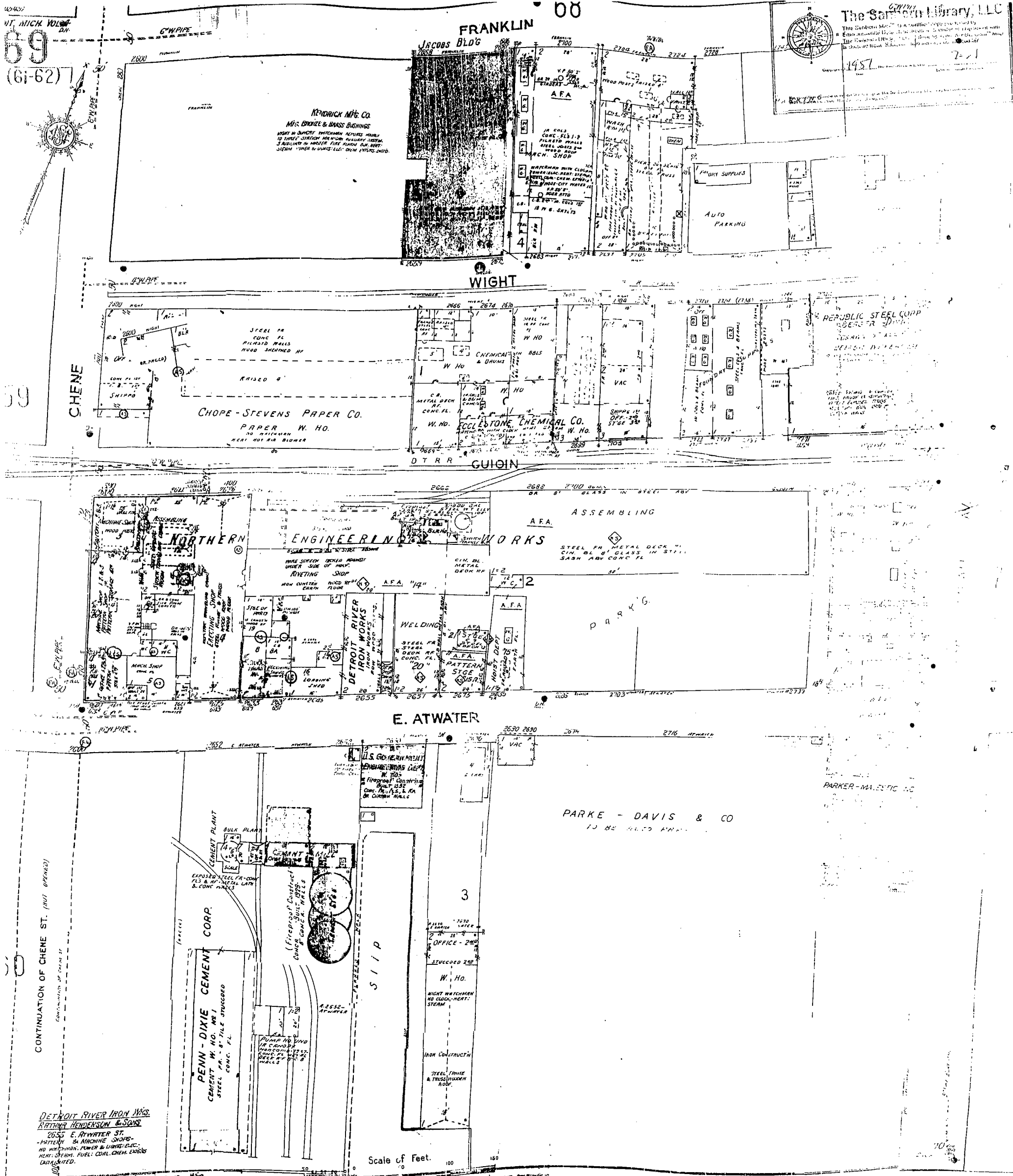
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-NO WATCHMAN, POWER & LIGHTS ETC.
-HEAT, STEAM, FUEL: COAL, CHEM. LOGS
-DISTILLATED.

REPUBLIC STEEL CORP.
REPUBLIC STEEL CORP.
REPUBLIC STEEL CORP.
REPUBLIC STEEL CORP.

CHOPE-STEVENS PAPER CO.
PAPER W. HO.
HEAT & AIR BLOWER

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W. HO.
CHEMICALS & DRUGS

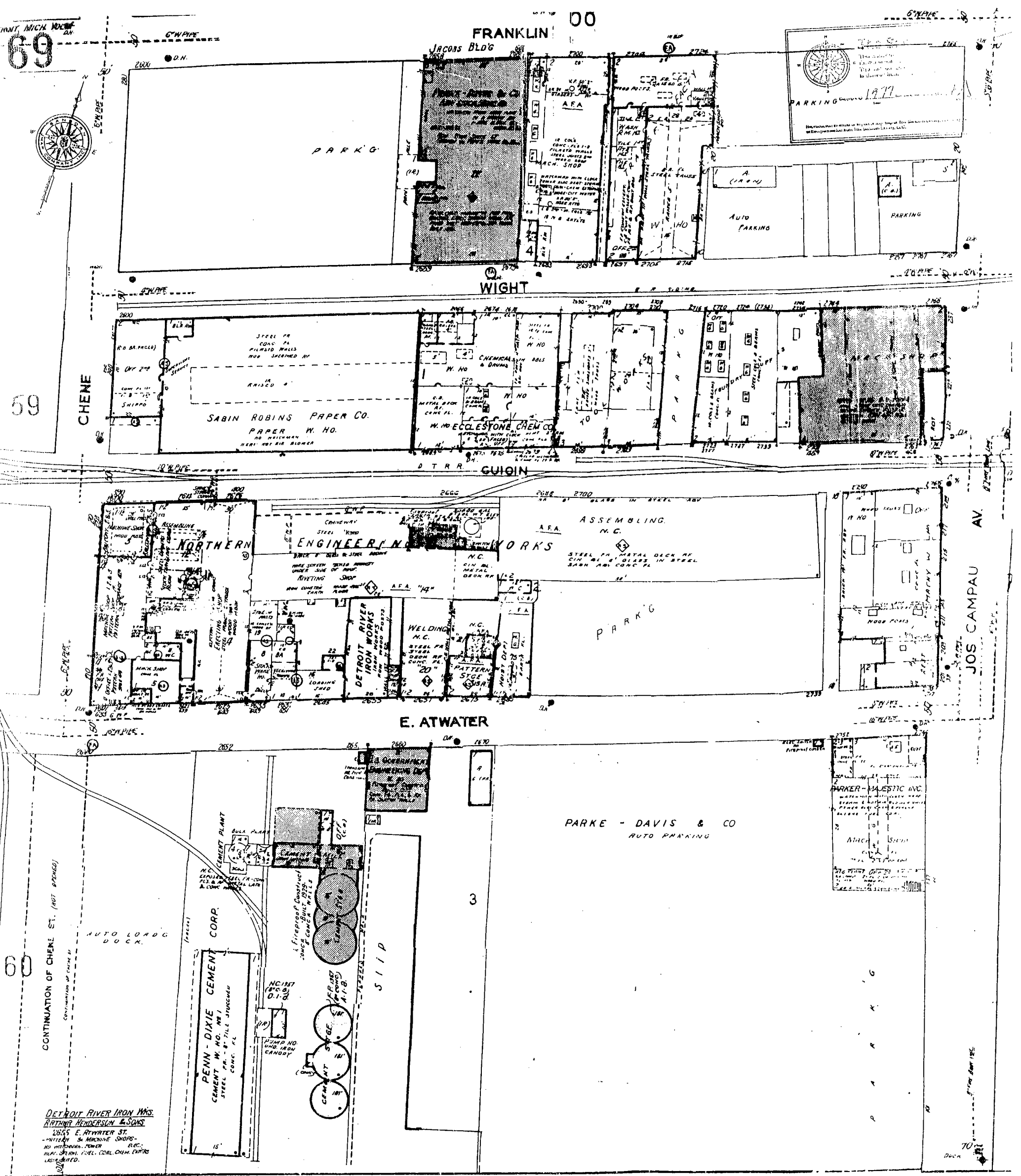
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WELDING SHOP
STEEL FAB. METAL DECK
CIN. BL. METAL DECK

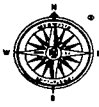
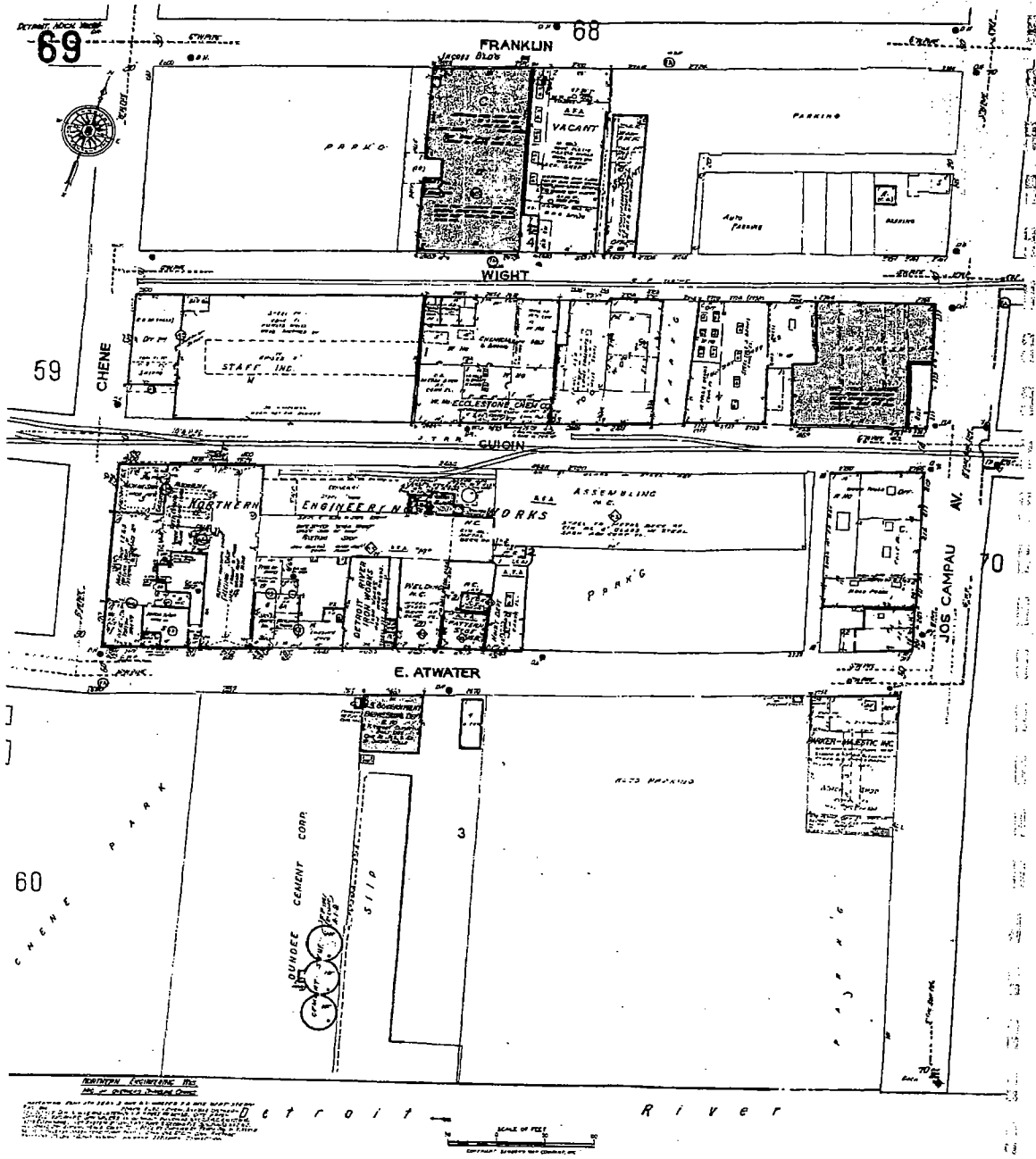
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STEEL CONC. FL.

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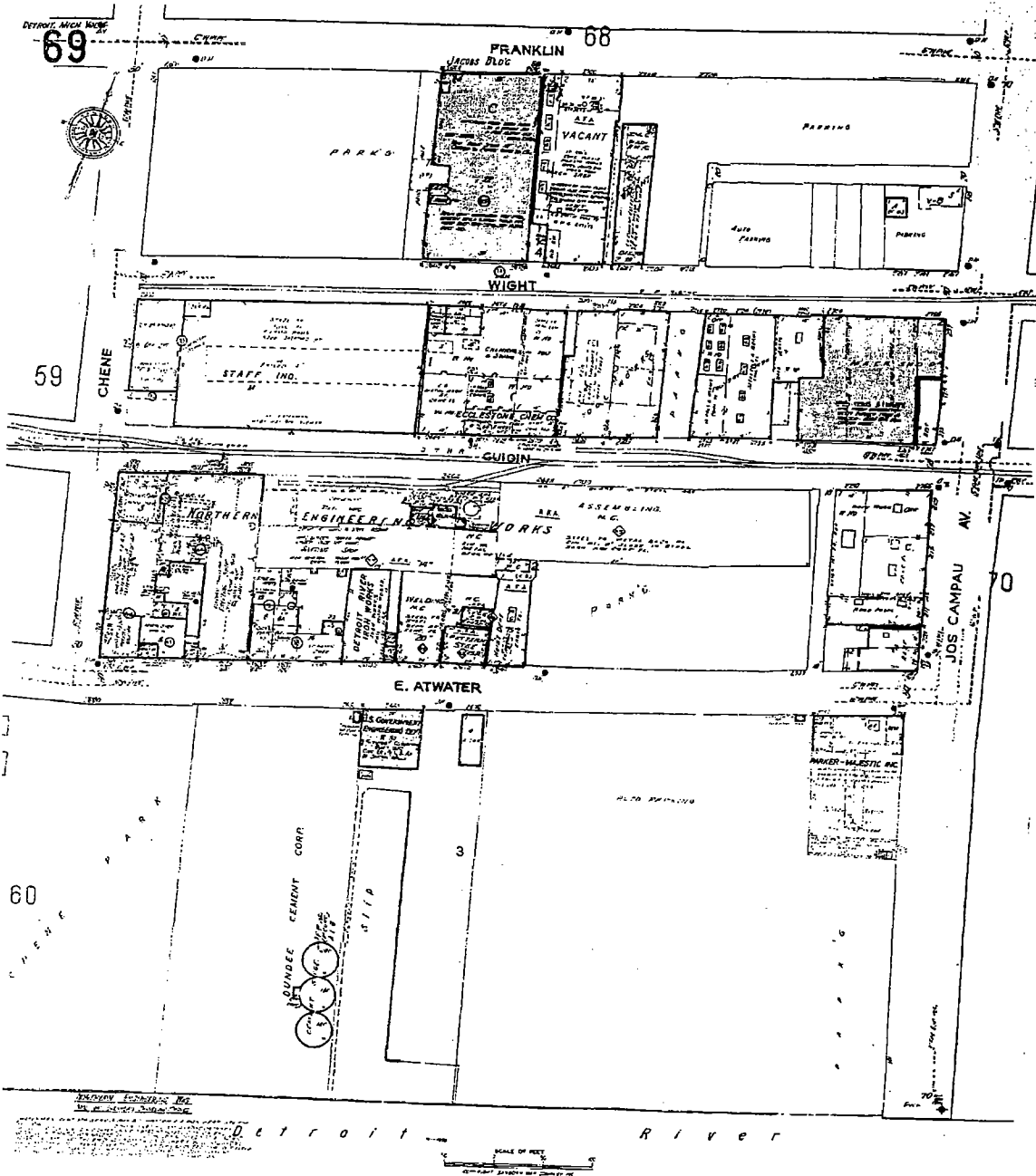


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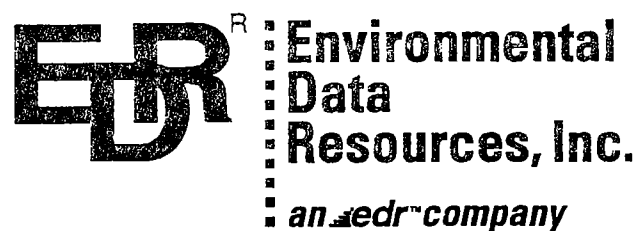


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SITE

Year 1937

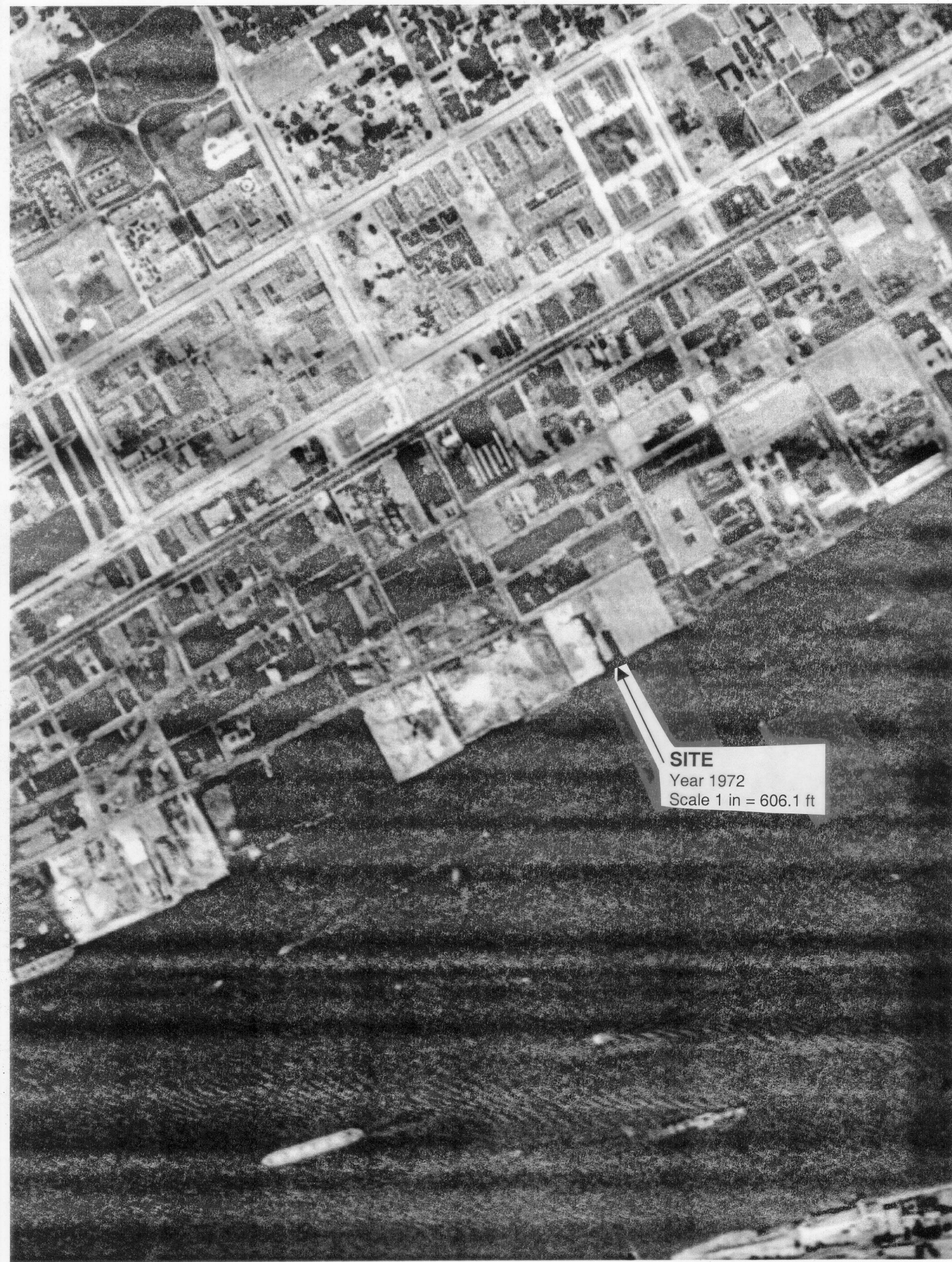
Scale 1 in = 555.6 ft



SITE

Year 1957

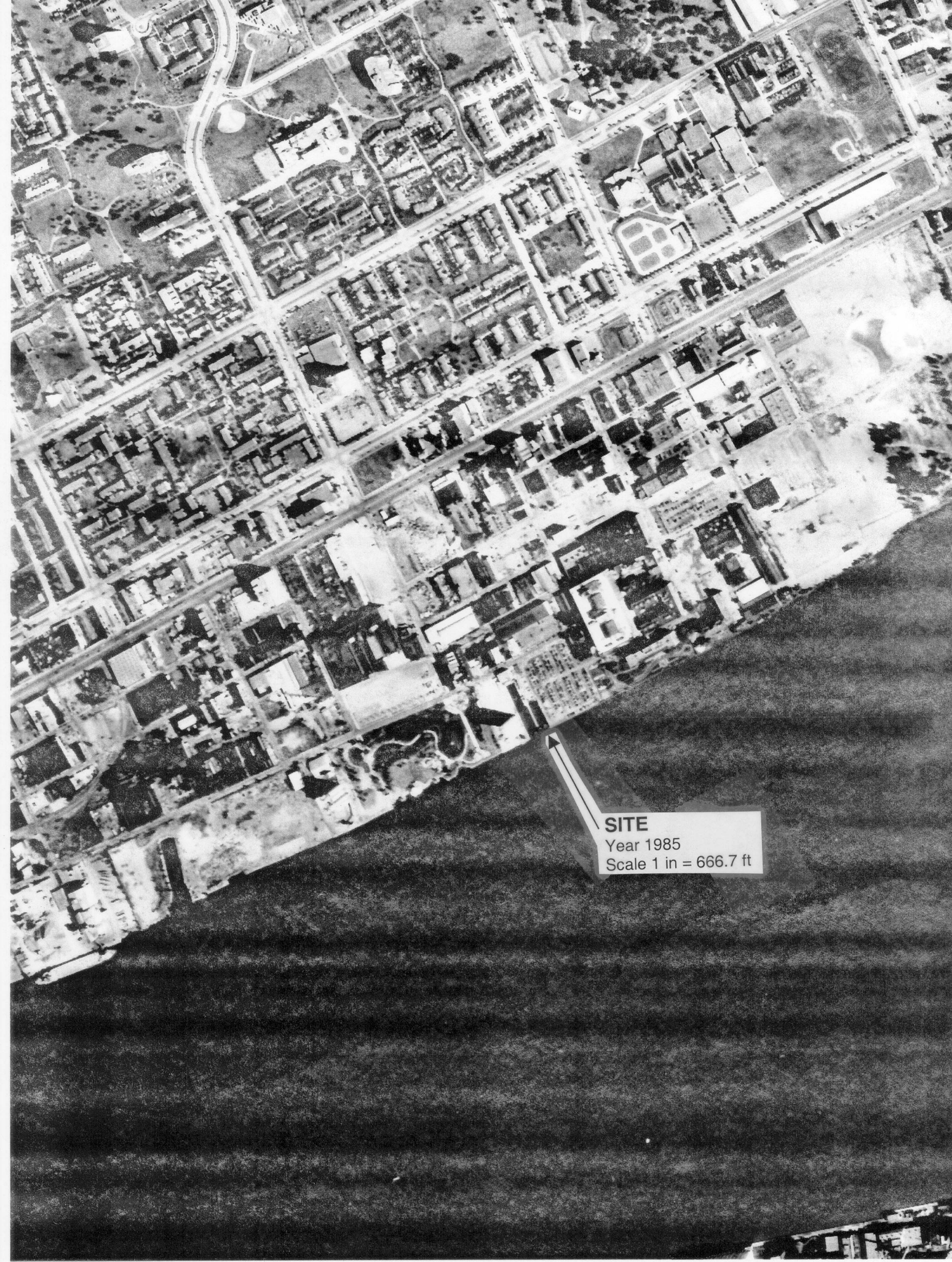
Scale 1 in = 555.6 ft



SITE

Year 1972

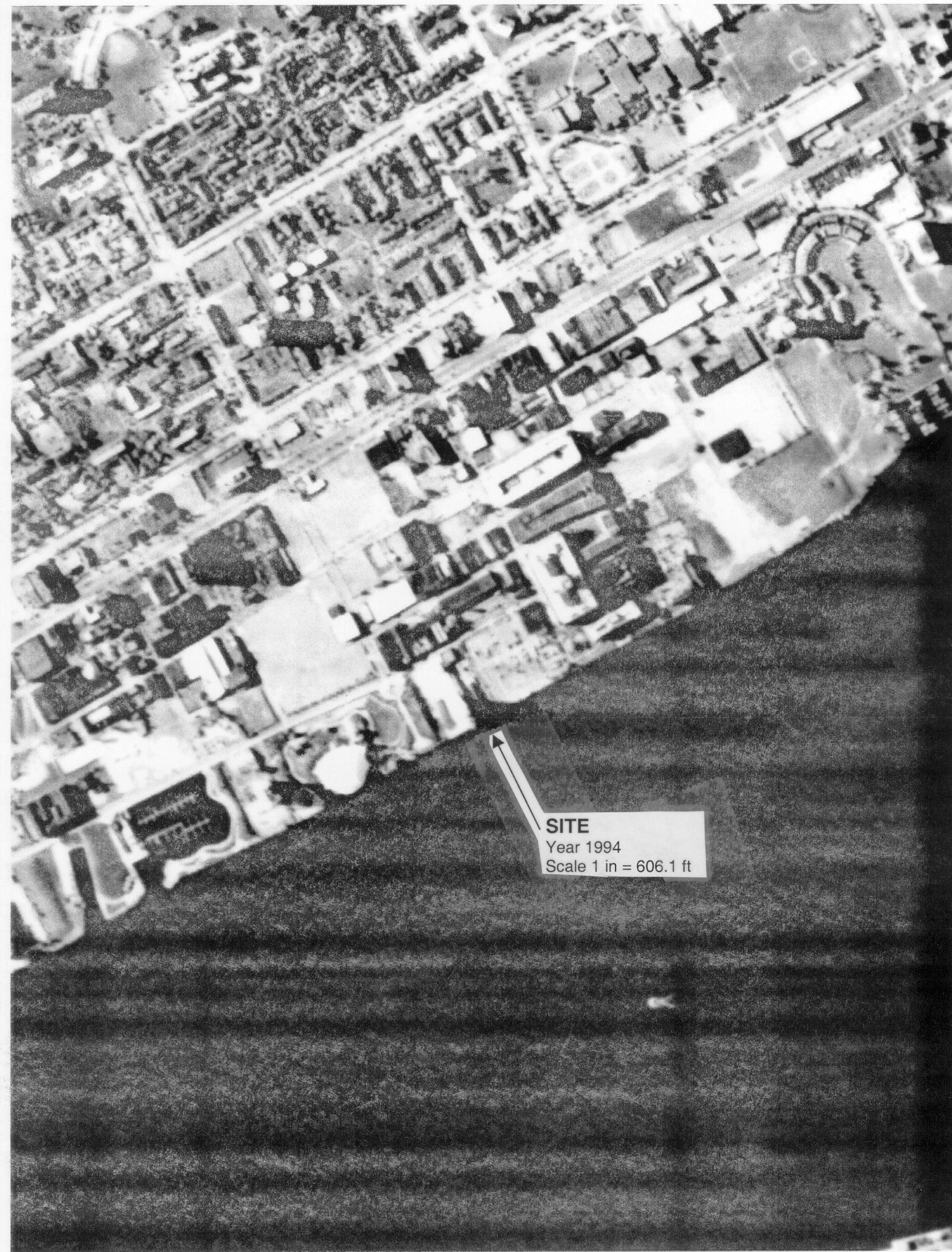
Scale 1 in = 606.1 ft



SITE

Year 1985

Scale 1 in = 666.7 ft



SITE

Year 1994

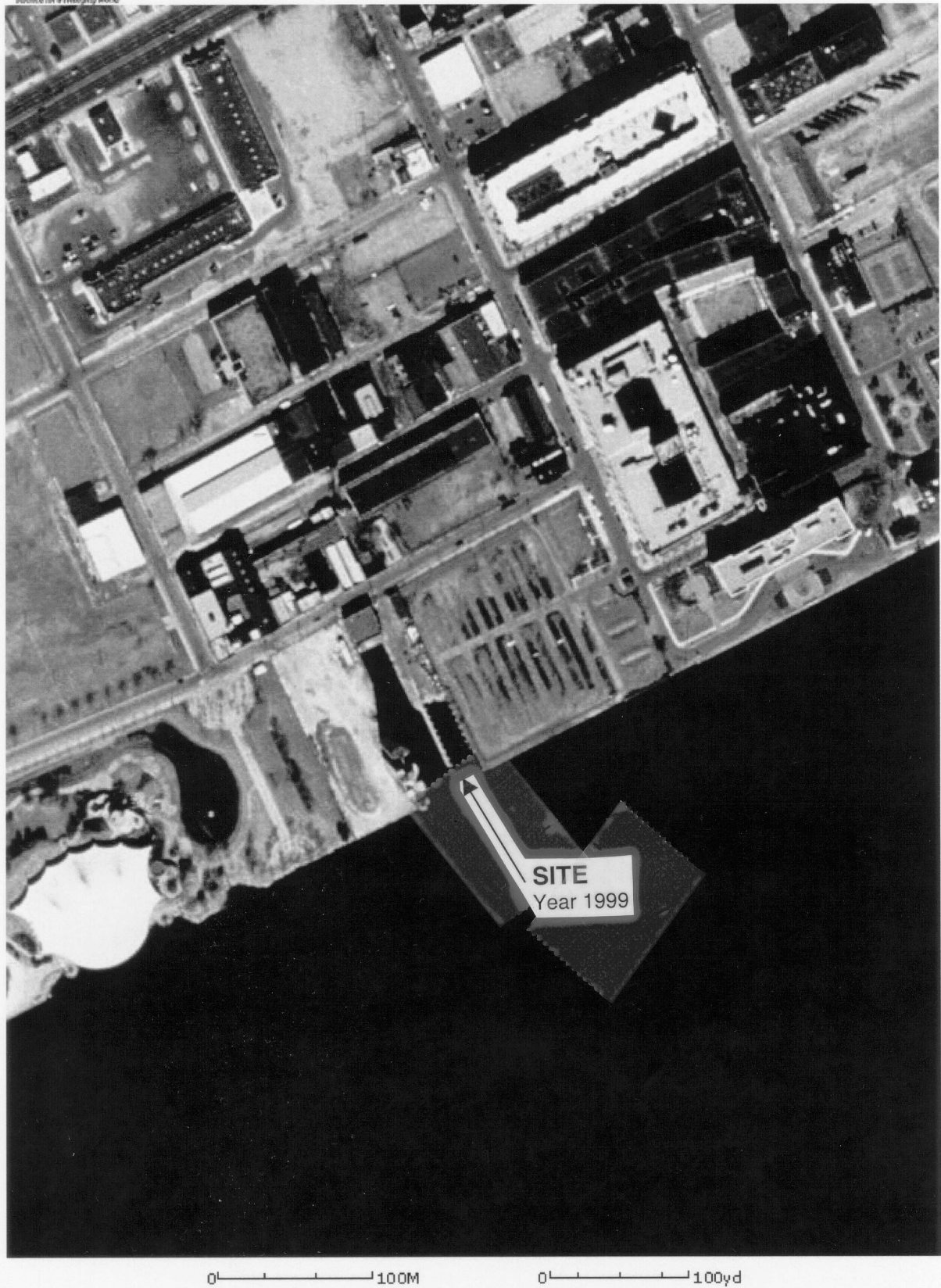
Scale 1 in = 606.1 ft

Microsoft TerraServer

Display Image

USGS Aerial Photograph

Detroit, Michigan, United States 28 Mar 1999



APPENDIX C

ENVIRONMENTAL RECORD SEARCH REPORT

THE EDR RADIUS MAP WITH GEOCHECK

EDR NEPA CHECK

THE EDR-CITY DIRECTORY



The EDR Radius Map with GeoCheck®

**USCG Detroit Atwater Property
2660 E. Atwater St
Detroit, MI 48207**

Inquiry Number: 625908.4s

May 01, 2001

The Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

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Map Findings Summary	4
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Orphan Summary	16
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 <u>GEOCHECK ADDENDUM</u>	
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Physical Setting Source Summary	A-2
Physical Setting Source Map	A-6
Physical Setting Source Map Findings	A-7
Physical Setting Source Records Searched	A-9

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The report meets the government records search requirements of ASTM Standard Practice for Environmental Site Assessments, E 1527-00. Search distances are per ASTM standard or custom distances requested by the user.

TARGET PROPERTY INFORMATION

ADDRESS

2660 E. ATWATER ST
DETROIT, MI 48207

COORDINATES

Latitude (North): 42.335300 - 42° 20' 7.1"
Longitude (West): 83.019200 - 83° 1' 9.1"
Universal Transverse Mercator: Zone 17
UTM X (Meters): 333647.5
UTM Y (Meters): 4688766.0

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property: 2442083-C1 DETROIT, MI CA08
Source: USGS 7.5 min quad index

TARGET PROPERTY SEARCH RESULTS

The target property was not listed in any of the databases searched by EDR.

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the target property or within the ASTM E 1527-00 search radius around the target property for the following databases:

FEDERAL ASTM STANDARD

NPL..... National Priority List
Proposed NPL..... Proposed National Priority List Sites
CERCLIS..... Comprehensive Environmental Response, Compensation, and Liability Information System
CERC-NFRAP..... CERCLIS No Further Remedial Action Planned
CORRACTS..... Corrective Action Report
RCRIS-TSD..... Resource Conservation and Recovery Information System
RCRIS-LQG..... Resource Conservation and Recovery Information System
ERNS..... Emergency Response Notification System

STATE ASTM STANDARD

SWF/LF..... Solid Waste Facilities Database

FEDERAL ASTM SUPPLEMENTAL

CONSENT..... Superfund (CERCLA) Consent Decrees

EXECUTIVE SUMMARY

ROD	Records Of Decision
Delisted NPL	National Priority List Deletions
FINDS	Facility Index System/Facility Identification Initiative Program Summary Report
HMIRS	Hazardous Materials Information Reporting System
MLTS	Material Licensing Tracking System
MINES	Mines Master Index File
NPL Liens	Federal Superfund Liens
PADS	PCB Activity Database System
RAATS	RCRA Administrative Action Tracking System
TRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

STATE OR LOCAL ASTM SUPPLEMENTAL

AST	Aboveground Tanks
------------------	-------------------

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified.

Elevations have been determined from the USGS 1 degree Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified. EDR's definition of a site with an elevation equal to the target property includes a tolerance of +/- 10 feet. Sites with an elevation equal to or higher than the target property have been differentiated below from sites with an elevation lower than the target property (by more than 10 feet). Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

FEDERAL ASTM STANDARD

RCRIS: The Resource Conservation and Recovery Act database includes selected information on sites that generate, store, treat, or dispose of hazardous waste as defined by the Act. The source of this database is the U.S. EPA.

A review of the RCRIS-SQG list, as provided by EDR, and dated 06/21/2000 has revealed that there are 4 RCRIS-SQG sites within approximately 0.25 miles of the target property.

<u>Equal/Higher Elevation</u>	<u>Address</u>	<u>Dist / Dir</u>	<u>Map ID</u>	<u>Page</u>
<i>THE STROH COMPANIES INC</i>	<i>210 CHENE</i>	<i>0 - 1/8 W</i>	<i>A1</i>	<i>5</i>
<i>STAFF INDUSTRIES INC</i>	<i>240 CHENE ST</i>	<i>0 - 1/8 WNW</i>	<i>A2</i>	<i>5</i>
<i>BLUTO INC</i>	<i>2720 WIGHT ST</i>	<i>0 - 1/8 NNW</i>	<i>B4</i>	<i>6</i>
<i>DONGAN ELECTRIC MFG CO</i>	<i>2987 FRANKLIN AVE</i>	<i>1/8 - 1/4 NNE</i>	<i>8</i>	<i>8</i>

EXECUTIVE SUMMARY

STATE ASTM STANDARD

SHWS: The State Hazardous Waste Sites records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. The data come from the Department of Environmental Quality's Contaminated Sites List on Diskette With Address.

A review of the SHWS list, as provided by EDR, has revealed that there are 3 SHWS sites within approximately 1 mile of the target property.

<u>Equal/Higher Elevation</u>	<u>Address</u>	<u>Dist / Dir</u>	<u>Map ID</u>	<u>Page</u>
A.T. WAGNER PROPERTY	2720 WIGHT ST	0 - 1/8 NNW	B5	7
MICH CON GAS CO STATION B	JEFFERSON / MELDRUM	1/2 - 1 NE	21	15
UNIROYAL PROPERTIES	6600 E JEFFERSON AVE	1/2 - 1 NE	22	15

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the Department of Environmental Quality's Leaking Underground Storage Tank (LUST) Database.

A review of the LUST list, as provided by EDR, and dated 01/12/2001 has revealed that there are 14 LUST sites within approximately 0.5 miles of the target property.

<u>Equal/Higher Elevation</u>	<u>Address</u>	<u>Dist / Dir</u>	<u>Map ID</u>	<u>Page</u>
PARKER MAJESTIC PROPERTY	147 JOSEPH CAMPAU	0 - 1/8 NE	3	6
ABANDONED BLDG (DEMOLISHED)	2700 FRANKLIN	1/8 - 1/4 NNW	7	7
MEDUSA CEMENT CO	2122 E ATWATER ST	1/4 - 1/2 WSW	9	8
COMERICA INC	2700 E JEFFERSON	1/4 - 1/2 NNW	C10	8
VACANT PROPERTY	2661 E JEFFERSON	1/4 - 1/2 NW	C11	9
PARKING LOT	2907 E JEFFERSON	1/4 - 1/2 NNW	12	9
SHELL SERVICE STATION	2600 E JEFFERSON/CHENE	1/4 - 1/2 NW	13	10
DEACONESS HOSPITAL	3245 E JEFFERSON	1/4 - 1/2 N	14	11
TRENT AUTO WASH INC	3501 JEFFERSON	1/4 - 1/2 N	15	11
JEFFERSON CHEVROLET	2130 JEFFERSON	1/4 - 1/2 WNW	16	12
FORMER MICHIGAN STEEL CASTING	1971 GUOIN	1/4 - 1/2 WSW	17	12
MOBIL OIL SS #03-G91	2010 E JEFFERSON	1/4 - 1/2 W	18	13
GLOBE TRADING COMPANY	1801 ATWATER ST	1/4 - 1/2 WSW	19	14
RIVERSIDE FORD INC	1833 E JEFFERSON	1/4 - 1/2 W	20	14

UST: The Underground Storage Tank database contains registered USTs. USTs are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA). The data come from the Department of Environmental Quality's Michigan UST database.

A review of the UST list, as provided by EDR, and dated 01/02/2001 has revealed that there is 1 UST site within approximately 0.25 miles of the target property.

<u>Equal/Higher Elevation</u>	<u>Address</u>	<u>Dist / Dir</u>	<u>Map ID</u>	<u>Page</u>
PARKER MAJESTIC PROPERTY	147 JOSEPH CAMPAU	0 - 1/8 NE	3	6

EXECUTIVE SUMMARY

PROPRIETARY DATABASES

Former Manufactured Gas (Coal Gas) Sites:

The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative

A review of the Coal Gas list, as provided by EDR, has revealed that there is 1 Coal Gas site within approximately 1 mile of the target property.

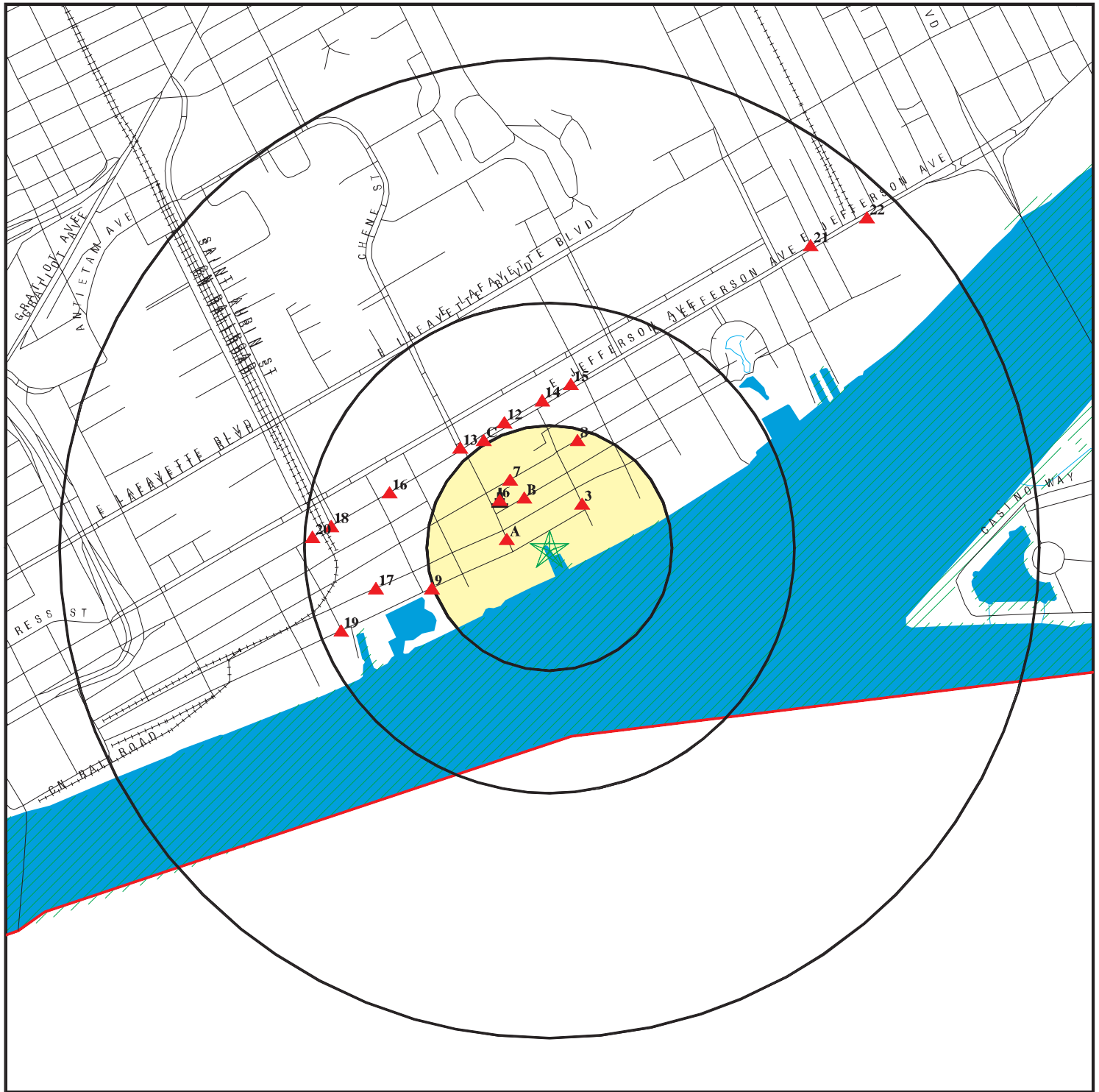
<u>Equal/Higher Elevation</u>	<u>Address</u>	<u>Dist / Dir</u>	<u>Map ID</u>	<u>Page</u>
DETROIT GAS CO. CHENE STREET S	2660 FRANKLIN STREET; 3	1/8 - 1/4NW	6	7

EXECUTIVE SUMMARY

Due to poor or inadequate address information, the following sites were not mapped:

<u>Site Name</u>	<u>Database(s)</u>
CHESAPEAKE PROPERTIES	SHWS
PACKARD PLANT (FORMER)	SHWS
UNISYS WORLD HQ DETROIT	SHWS
WARRENDALE ROUGE DUMP	SHWS
TROY AUTO PARTS	SHWS
VANBORN AND LILLY RD SITE	SHWS
MCNICHOL MERCURY SPILL	CERCLIS
DETROIT ECONOMIC CAR	LUST
CITY OF DETROIT	LUST

OVERVIEW MAP - 625908.4s - Tetra Tech NUS, Inc.



- ★ Target Property
- ▲ Sites at elevations higher than or equal to the target property
- ◆ Sites at elevations lower than the target property
- ⚙ Coal Gasification Sites (if requested)
- 🔴 National Priority List Sites
- 🔵 Landfill Sites

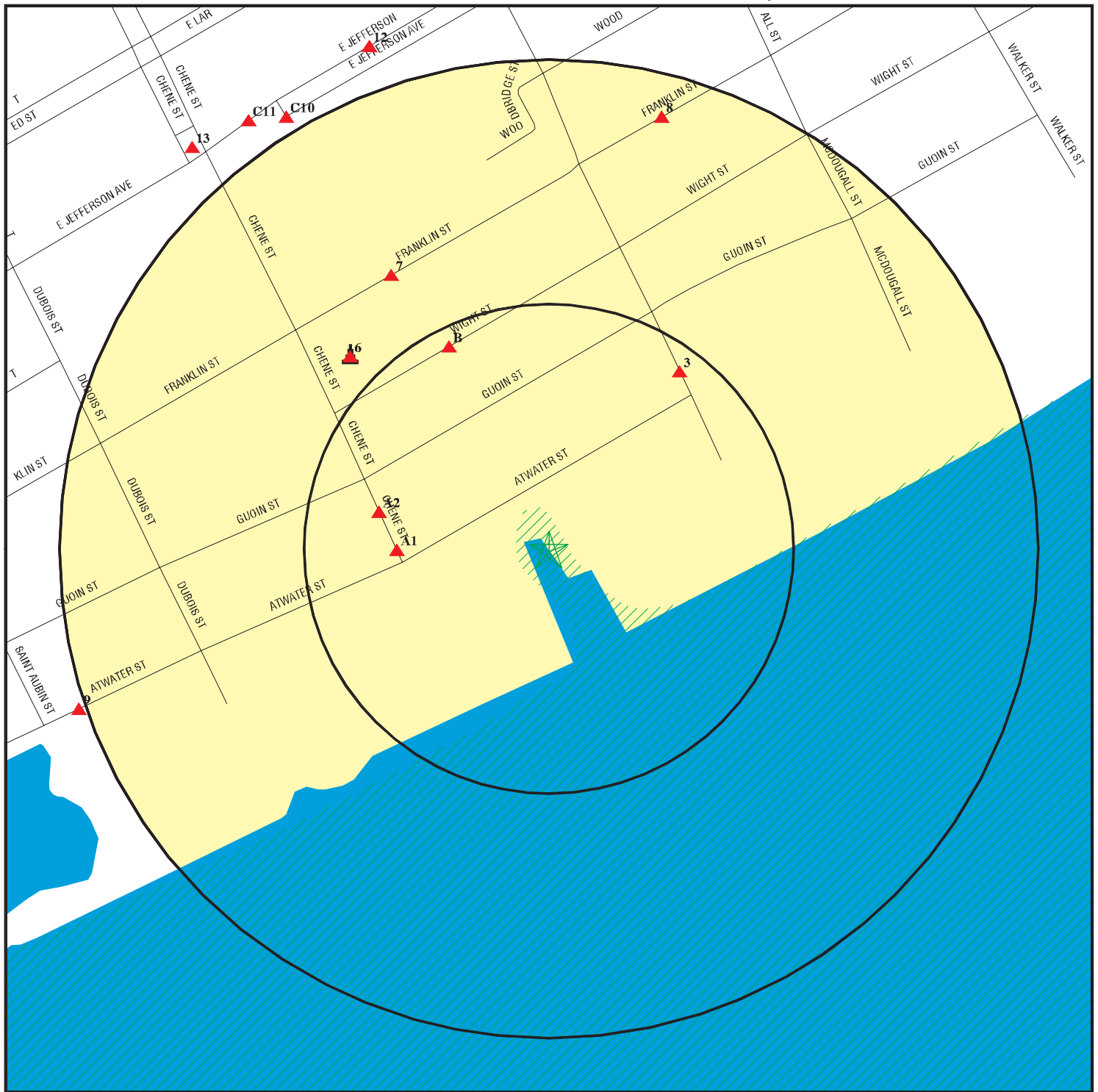
- ⚡ Power transmission lines
- ⚡ Oil & Gas pipelines
- 🟦 100-year flood zone
- 🟢 500-year flood zone



TARGET PROPERTY: USCG Detroit Atwater Property
 ADDRESS: 2660 E. Atwater St
 CITY/STATE/ZIP: Detroit MI 48207
 LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
 CONTACT: Robert Davis
 INQUIRY #: 625908.4s
 DATE: May 01, 2001 10:47 am

DETAIL MAP - 625908.4s - Tetra Tech NUS, Inc.



- ★ Target Property
- ▲ Sites at elevations higher than or equal to the target property
- ◆ Sites at elevations lower than the target property
- ▲ Coal Gasification Sites (if requested)
- Sensitive Receptors
- National Priority List Sites
- Landfill Sites

- Power transmission lines
- Oil & Gas pipelines
- ▨ 100-year flood zone
- ▨ 500-year flood zone

0 1/16 1/8 1/4 Miles



TARGET PROPERTY: USCG Detroit Atwater Property
 ADDRESS: 2660 E. Atwater St
 CITY/STATE/ZIP: Detroit MI 48207
 LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
 CONTACT: Robert Davis
 INQUIRY #: 625908.4s
 DATE: May 01, 2001 10:48 am

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
<u>FEDERAL ASTM STANDARD</u>								
NPL		1.000	0	0	0	0	NR	0
Proposed NPL		1.000	0	0	0	0	NR	0
CERCLIS		0.500	0	0	0	NR	NR	0
CERC-NFRAP		0.250	0	0	NR	NR	NR	0
CORRACTS		1.000	0	0	0	0	NR	0
RCRIS-TSD		0.500	0	0	0	NR	NR	0
RCRIS Lg. Quan. Gen.		0.250	0	0	NR	NR	NR	0
RCRIS Sm. Quan. Gen.		0.250	3	1	NR	NR	NR	4
ERNS		TP	NR	NR	NR	NR	NR	0
<u>STATE ASTM STANDARD</u>								
State Haz. Waste		1.000	1	0	0	2	NR	3
State Landfill		0.500	0	0	0	NR	NR	0
LUST		0.500	1	1	12	NR	NR	14
UST		0.250	1	0	NR	NR	NR	1
<u>FEDERAL ASTM SUPPLEMENTAL</u>								
CONSENT		1.000	0	0	0	0	NR	0
ROD		1.000	0	0	0	0	NR	0
Delisted NPL		1.000	0	0	0	0	NR	0
FINDS		TP	NR	NR	NR	NR	NR	0
HMIRS		TP	NR	NR	NR	NR	NR	0
MLTS		TP	NR	NR	NR	NR	NR	0
MINES		0.250	0	0	NR	NR	NR	0
NPL Liens		TP	NR	NR	NR	NR	NR	0
PADS		TP	NR	NR	NR	NR	NR	0
RAATS		TP	NR	NR	NR	NR	NR	0
TRIS		TP	NR	NR	NR	NR	NR	0
TSCA		TP	NR	NR	NR	NR	NR	0
FTTS		TP	NR	NR	NR	NR	NR	0
<u>STATE OR LOCAL ASTM SUPPLEMENTAL</u>								
AST		TP	NR	NR	NR	NR	NR	0
<u>EDR PROPRIETARY DATABASES</u>								
Coal Gas		1.000	0	1	0	0	NR	1
AQUIFLOW - see EDR Physical Setting Source Addendum								

TP = Target Property

NR = Not Requested at this Search Distance

* Sites may be listed in more than one database

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

Site

Database(s)

EDR ID Number
EPA ID Number

A1
West
< 1/8
409
Higher
THE STROH COMPANIES INC
210 CHENE
DETROIT, MI 48207
Site 1 of 2 in cluster A

RCRIS-SQG
FINDS
1000528542
MID985609619

RCRIS:

Owner: THE STROH COMPANIES INC
(313) 446-2121

Contact: MONTY KAMPF
(313) 259-1345

Record Date: 04/01/1991

Classification: Not reported

Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	05/13/1993
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/04/1993
Actual Date Achieved Compliance:	06/08/1993
Enforcement Action:	Written Informal
Enforcement Action Date:	05/13/1993
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-Land Ban Requirements
Date Violation Determined:	05/13/1993
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/04/1993
Actual Date Achieved Compliance:	06/08/1993
Enforcement Action:	Written Informal
Enforcement Action Date:	05/13/1993
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 2 violation record(s) reported at this site:

Evaluation
Compliance Evaluation Inspection (CEI)

Area of Violation
Generator-All Requirements
Generator-Land Ban Requirements

Date of Compliance
06/08/1993
06/08/1993

A2
WNW
< 1/8
468
Higher
STAFF INDUSTRIES INC
240 CHENE ST
DETROIT, MI 48207
Site 2 of 2 in cluster A

RCRIS-SQG
FINDS
1000228731
MID006001077

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

STAFF INDUSTRIES INC (Continued)

EDR ID Number
EPA ID Number

Database(s)

1000228731

RCRIS:

Owner: STAFF INDUSTRIES INC
(312) 555-1212

Contact: GARY LECHNER
(313) 259-1818

Record Date: 03/20/1989

Classification: Small Quantity Generator

Used Oil Recyc: No

Violation Status: No violations found

**3
NE
< 1/8
595
Higher**

**PARKER MAJESTIC PROPERTY
147 JOSEPH CAMPAU
DETROIT, MI 48207**

**UST U002303454
LUST N/A**

LUST:

Facility ID: 0-038448
Facility Status: CLOSED
Region: STATE

UST:

Facility ID: 0038448
Tank ID: 1
Owner: STROH PROP INC
Owner Address: 300 RIVER PLACE
DETROIT, MI
Product: Diesel
Capacity: 6,000

Owner Phone: (313) 446-5000

Facility ID: 0038448
Tank ID: 2
Owner: STROH PROP INC
Owner Address: 300 RIVER PLACE
DETROIT, MI
Product: BOILER/FUEL
Capacity: 4,000

Owner Phone: (313) 446-5000

**B4
NNW
< 1/8
609
Higher**

**BLUTO INC
2720 WIGHT ST
DETROIT, MI 48207
Site 1 of 2 in cluster B**

**RCRIS-SQG 1000313075
FINDS MID005382577**

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

BLUTO INC (Continued)

EDR ID Number
EPA ID Number

Database(s)

1000313075

RCRIS:

Owner: BLUTO INC
(800) 800-8098

Contact: KENNETH WRAY
(313) 259-3220

Record Date: 12/05/1980

Classification: Small Quantity Generator

Used Oil Recyc: No

Violation Status: No violations found

**B5
NNW
< 1/8
609
Higher**

**A.T. WAGNER PROPERTY
2720 WIGHT ST
DETROIT, MI 48207**

**SHWS S104005124
N/A**

Site 2 of 2 in cluster B

SHWS:

Facility ID: 821588
Facility Status: Eval/Interim Resp-PRP/Oth
Source: Industrial Organic Chemicals
Pollutant(s): Trichloroethylene, Tetrachloroethylene, Vinyl Chloride
SAM Score: 36
SAM Score Date: 11/18/98 0:00:00
Township: 2S
Range: 12E
Section: 10
Quarter: C
Quarter/Quarter: A
Change: NEW
Change Date: 2/11/99 0:00:00
County Code: 82

**6
NW
1/8-1/4
746
Higher**

**DETROIT GAS CO. CHENE STREET STATION
2660 FRANKLIN STREET; 38 CHENE STREET
DETROIT, MI 48207**

**Coal Gas G000001365
N/A**

COAL GAS SITE DESCRIPTION:

Detroit Gas Co. Chene Street Station site is located on the east side of Chene St., south of Franklin and north of Wight Street. 1921, site is vacant.

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**7
NNW
1/8-1/4
852
Higher**

**ABANDONED BLDG (DEMOLISHED)
2700 FRANKLIN
DETROIT, MI**

**LUST S104872563
N/A**

LUST:

Facility ID: 5-002643
Facility Status: CLOSED
Region: STATE

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

Site

Database(s)

EDR ID Number
EPA ID Number

8
NNE
1/8-1/4
1205
Higher

DONGAN ELECTRIC MFG CO
2987 FRANKLIN AVE
DETROIT, MI 48207

RCRIS-SQG
FINDS

1000232598
MID005321179

RCRIS:

Owner: HICKS C E
(312) 555-1212
Contact: ED TOLLAFIELD
(313) 567-8500
Record Date: 09/17/1998
Classification: Small Quantity Generator
Used Oil Recyc: No
Violation Status: No violations found

9
WSW
1/4-1/2
1338
Higher

MEDUSA CEMENT CO
2122 E ATWATER ST
DETROIT, MI 48207

UST
LUST

U003321070
N/A

LUST:

Facility ID: 0-007374
Facility Status: OPEN
Region: STATE

UST:

Facility ID: 0007374
Tank ID: 1
Owner: MEDUSA CEMENT CO
Owner Address: 2122 E ATWATER
DETROIT, MI
Product: Gasoline
Capacity: 1,000

Owner Phone: (313) 259-3110

C10
NNW
1/4-1/2
1363
Higher

COMERICA INC
2700 E JEFFERSON
DETROIT, MI 48207

UST
LUST

U001147907
N/A

Site 1 of 2 in cluster C

LUST:

Facility ID: 0-036469
Facility Status: CLOSED
Region: STATE

UST:

Facility ID: 0036469
Tank ID: 1
Owner: COMERICA INC
Owner Address: C/O PETER FLEMING
AUBURN HILLS, MI
Product: UNK
Capacity: 10,000

Owner Phone: (313) 370-5213

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

	Site	Database(s)	EDR ID Number EPA ID Number
C11 NW 1/4-1/2 1411 Higher	VACANT PROPERTY 2661 E JEFFERSON DETROIT, MI 48207 Site 2 of 2 in cluster C RCRIS: Owner: DETROIT CITY OF CEDD (313) 224-3894 Contact: RICHARD RYBINSKI (313) 224-3894 Record Date: 08/10/1994 Classification: Conditionally Exempt Small Quantity Generator, Hazardous Waste Transporter Used Oil Recyc: No Violation Status: No violations found LUST: Facility ID: 0-037795 Facility Status: CLOSED Region: STATE UST: Facility ID: 0037795 Tank ID: 1 Owner: CITY OF DETROIT Owner Address: 150 MICHIGAN AVE DETROIT, MI Product: UNK Capacity: 1,000 Facility ID: 0037795 Tank ID: 2 Owner: CITY OF DETROIT Owner Address: 150 MICHIGAN AVE DETROIT, MI Product: MOTOR/OIL Capacity: 1,000 Facility ID: 0037795 Tank ID: 3 Owner: CITY OF DETROIT Owner Address: 150 MICHIGAN AVE DETROIT, MI Product: Gasoline Capacity: 2,000 Facility ID: 0037795 Tank ID: 4 Owner: CITY OF DETROIT Owner Address: 150 MICHIGAN AVE DETROIT, MI Product: Gasoline Capacity: 1,000	RCRIS-SQG FINDS UST LUST	1000909139 MI0000567719
12 NNW 1/4-1/2 1440 Higher	PARKING LOT 2907 E JEFFERSON DETROIT, MI 48207	UST LUST	U001148626 N/A

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

PARKING LOT (Continued)

U001148626

LUST:

Facility ID: 0-037270
Facility Status: CLOSED
Region: STATE

UST:

Facility ID: 0037270
Tank ID: 1
Owner: UNIV OF DETROIT/MERCY
Owner Address: 4001 W MCNICHOLS RD
DETROIT, MI
Product: Gasoline
Capacity: 6,000

Owner Phone: (313) 993-1133

**13
NW
1/4-1/2
1449
Higher**

**SHELL SERVICE STATION
2600 E JEFFERSON/CHENE
DETROIT, MI 48207**

**UST U003321915
LUST N/A**

LUST:

Facility ID: 0-010493
Facility Status: CLOSED
Region: STATE

UST:

Facility ID: 0010493
Tank ID: 1
Owner: EQUILON ENTERPRISES LLC
Owner Address: 41700 GARDENBROOK
NOVI, MI
Product: Gasoline
Capacity: 4,000

Owner Phone: (248) 347-6025

Facility ID: 0010493
Tank ID: 2
Owner: EQUILON ENTERPRISES LLC
Owner Address: 41700 GARDENBROOK
NOVI, MI
Product: Gasoline
Capacity: 6,000

Owner Phone: (248) 347-6025

Facility ID: 0010493
Tank ID: 3
Owner: EQUILON ENTERPRISES LLC
Owner Address: 41700 GARDENBROOK
NOVI, MI
Product: Gasoline
Capacity: 6,000

Owner Phone: (248) 347-6025

Facility ID: 0010493
Tank ID: 4
Owner: EQUILON ENTERPRISES LLC
Owner Address: 41700 GARDENBROOK
NOVI, MI
Product: Gasoline
Capacity: 10,000

Owner Phone: (248) 347-6025

Facility ID: 0010493

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

SHELL SERVICE STATION (Continued)

U003321915

Tank ID:	5	Owner Phone:	(248) 347-6025
Owner:	EQUILON ENTERPRISES LLC		
Owner Address:	41700 GARDENBROOK		
	NOVI, MI		
Product:	Used Oil		
Capacity:	1,000		
Facility ID:	0010493		
Tank ID:	8	Owner Phone:	(248) 347-6025
Owner:	EQUILON ENTERPRISES LLC		
Owner Address:	41700 GARDENBROOK		
	NOVI, MI		
Product:	Gasoline		
Capacity:	12,000		
Facility ID:	0010493		
Tank ID:	9	Owner Phone:	(248) 347-6025
Owner:	EQUILON ENTERPRISES LLC		
Owner Address:	41700 GARDENBROOK		
	NOVI, MI		
Product:	Gasoline		
Capacity:	12,000		

14
North
1/4-1/2
1595
Higher

DEACONESS HOSPITAL
3245 E JEFFERSON
DETROIT, MI 48826

UST U000268220
LUST N/A

LUST:

Facility ID:	0-034632		
Facility Status:	CLOSED		
Region:	STATE		

UST:

Facility ID:	0034632		
Tank ID:	1		
Owner:	MERCY HEALTH FOUNDATION	Owner Phone:	(000) 000-0000
Owner Address:	34605 W 12 MILE		
	FARMINGTON HILLS, MI		
Product:	UNK		
Capacity:	500		

15
North
1/4-1/2
1783
Higher

TRENT AUTO WASH INC
3501 JEFFERSON
DETROIT, MI 48207

UST U003320156
LUST N/A

LUST:

Facility ID:	0-003907		
Facility Status:	OPEN		
Region:	STATE		

UST:

Facility ID:	0003907		
Tank ID:	1		
Owner:	TRENT AUTO WASH INC	Owner Phone:	(313) 259-3506
Owner Address:	3501 JEFFERSON		

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

TRENT AUTO WASH INC (Continued)

U003320156

Product: DETROIT, MI
Gasoline
Capacity: 10,000

Facility ID: 0003907
Tank ID: 2
Owner: TRENT AUTO WASH INC
Owner Address: 3501 JEFFERSON
DETROIT, MI
Product: Gasoline
Capacity: 10,000

Facility ID: 0003907
Tank ID: 3
Owner: TRENT AUTO WASH INC
Owner Address: 3501 JEFFERSON
DETROIT, MI
Product: Gasoline
Capacity: 12,000

Owner Phone: (313) 259-3506
Owner Phone: (313) 259-3506

**16
WNW
1/4-1/2
1824
Higher**

**JEFFERSON CHEVROLET
2130 JEFFERSON
DETROIT, MI 48207**

**RCRIS-SQG 1000228355
FINDS MID006534598
UST
LUST**

RCRIS:
Owner: TESSMER RAY
(312) 555-1212

Contact: JAMES TELLIER
(313) 259-1200

Record Date: 02/09/1987
Classification: Small Quantity Generator
Used Oil Recyc: No
Violation Status: No violations found

LUST:
Facility ID: 0-018548
Facility Status: OPEN
Region: STATE

UST:
Facility ID: 0018548
Tank ID: 1
Owner: JEFFERSON CHEV COL
Owner Address: 2130 E JEFFERSON AVE
DETROIT, MI
Product: Used Oil
Capacity: 500

Owner Phone: (313) 259-1200

**17
WSW
1/4-1/2
1917
Higher**

**FORMER MICHIGAN STEEL CASTING
1971 GUOIN
DETROIT, MI 48207**

**UST U003426396
LUST N/A**

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

FORMER MICHIGAN STEEL CASTING (Continued)

EDR ID Number
EPA ID Number

Database(s)

U003426396

LUST:

Facility ID: 0-039814
Facility Status: CLOSED
Region: STATE

UST:

Facility ID: 0039814
Tank ID: 1
Owner: JEFFERSON LAND INC
Owner Address: 1900 E JEFFERSON AVE
DETROIT, MI
Product: Gasoline
Capacity: 1,000

Owner Phone: (313) 567-4480

**18
West
1/4-1/2
2362
Higher**

**MOBIL OIL SS #03-G91
2010 E JEFFERSON
DETROIT, MI 48207**

**UST U003426025
LUST N/A**

LUST:

Facility ID: 0-016622
Facility Status: OPEN
Region: STATE

UST:

Facility ID: 0016622
Tank ID: 1
Owner: MOBIL OIL CORP
Owner Address: %TANKNOLOGY
AUSTIN, TX
Product: Gasoline
Capacity: 12,000

Owner Phone: (512) 451-6334

Facility ID: 0016622
Tank ID: 2
Owner: MOBIL OIL CORP
Owner Address: %TANKNOLOGY
AUSTIN, TX
Product: Gasoline
Capacity: 8,000

Owner Phone: (512) 451-6334

Facility ID: 0016622
Tank ID: 3
Owner: MOBIL OIL CORP
Owner Address: %TANKNOLOGY
AUSTIN, TX
Product: Gasoline
Capacity: 6,000

Owner Phone: (512) 451-6334

Facility ID: 0016622
Tank ID: 4
Owner: MOBIL OIL CORP
Owner Address: %TANKNOLOGY
AUSTIN, TX
Product: Used Oil
Capacity: 1,000

Owner Phone: (512) 451-6334

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

Site

Database(s)

EDR ID Number
EPA ID Number

19
WSW
1/4-1/2
2411
Higher

GLOBE TRADING COMPANY
1801 ATWATER ST
DETROIT, MI

LUST **S103028806**
N/A

LUST:

Facility ID: 5-000028
Facility Status: OPEN
Region: STATE

20
West
1/4-1/2
2554
Higher

RIVERSIDE FORD INC
1833 E JEFFERSON
DETROIT, MI 48207

RCRIS-SQG **1000218204**
FINDS **MID109195412**
UST
LUST

RCRIS:

Owner: CONYERS NATE
(312) 555-1212

Contact: NELSON SHIPE
(313) 567-0250

Record Date: 09/14/1987
Classification: Small Quantity Generator
Used Oil Recyc: No
Violation Status: No violations found

LUST:

Facility ID: 0-010648
Facility Status: CLOSED
Region: STATE

UST:

Facility ID: 0010648
Tank ID: 1
Owner: TOM HOLZER FORD INC
Owner Address: 39300 W 10 MILE
FARMINGTON HILLS, MI
Product: Used Oil
Capacity: UNK

Owner Phone: (313) 474-1234

Facility ID: 0010648
Tank ID: 2
Owner: TOM HOLZER FORD INC
Owner Address: 39300 W 10 MILE
FARMINGTON HILLS, MI
Product: Not reported
Capacity: UNK

Owner Phone: (313) 474-1234

Facility ID: 0010648
Tank ID: 3
Owner: TOM HOLZER FORD INC
Owner Address: 39300 W 10 MILE
FARMINGTON HILLS, MI
Product: UNKNOWN
Capacity: 550

Owner Phone: (313) 474-1234

Map ID
Direction
Distance
Distance (ft.)
Elevation

MAP FINDINGS

Site

Database(s)

EDR ID Number
EPA ID Number

21
NE
1/2-1
4314
Higher

MICH CON GAS CO STATION B
JEFFERSON / MELDRUM
DETROIT, MI 48207

SHWS S103085275
N/A

SHWS:

Facility ID: 820029
Facility Status: Eval/Interim Resp-PRP/Oth
Source: Coal gasification
Pollutant(s): Benzene Xylene, Toluene PNA, Ethylbenzene
SAM Score: 36
SAM Score Date: 10/1/91 0:00:00
Township: 02S
Range: 12E
Section: Not reported
Quarter: Not reported
Quarter/Quarter: Not reported
Change: Rescored from 08 to 36
Change Date: 10/1/91 0:00:00
County Code: 82

22
NE
1/2-1
4943
Higher

UNIROYAL PROPERTIES
6600 E JEFFERSON AVE
DETROIT, MI 48207

SHWS S103594591
N/A

SHWS:

Facility ID: 820213
Facility Status: Eval/Interim Resp-PRP/Oth
Source: Rubber & Plastic Products
Pollutant(s): BTEX PNAs Cyanide, Carbon Disulfide
SAM Score: 39
SAM Score Date: 3/19/92 0:00:00
Township: 02S
Range: 12E
Section: 10
Quarter: A
Quarter/Quarter: B
Change: New Addition to List
Change Date: 8/28/92 0:00:00
County Code: 82

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
DETROIT	S103594578	CHESAPEAKE PROPERTIES	FORT ST WAREHOUSE		SHWS	820151
DETROIT	S104005128	PACKARD PLANT (FORMER)	GRAND BLVD. AT CONCORD		SHWS	821563
DETROIT	1003073082	MCNICHOL MERCURY SPILL	W. MCNICHOL STREET / WORMER ST		CERCLIS	
DETROIT	S103095077	UNISYS WORLD HQ DETROIT	ONE UNISYS PLACE		SHWS	820178
DETROIT	S102851828	DETROIT ECONOMIC CAR	PARCEL 169 - ST JEAN		LUST	5-001220
DETROIT	S104872593	CITY OF DETROIT	4161 SECOND AVE		LUST	5-002552
WAYNE COUNTY	S103095106	WARRENDALE ROUGE DUMP	HINES DRIVE NEAR TELEGRAPH		SHWS	821537
WAYNE COUNTY	S103095069	TROY AUTO PARTS	SEVEN MILE / ANTWERP		SHWS	820052
WAYNE COUNTY	S103095070	VANBORN AND LILLY RD SITE	VANBORN AND LILLEY		SHWS	820054

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM STANDARD RECORDS

NPL: National Priority List

Source: EPA

Telephone: N/A

National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC).

Date of Government Version: 01/23/01

Date Made Active at EDR: 02/16/01

Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 02/05/01

Elapsed ASTM days: 11

Date of Last EDR Contact: 02/05/01

Proposed NPL: Proposed National Priority List Sites

Source: EPA

Telephone: N/A

Date of Government Version: 01/23/01

Date Made Active at EDR: 02/16/01

Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 02/05/01

Elapsed ASTM days: 11

Date of Last EDR Contact: 02/05/01

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

Source: EPA

Telephone: 703-413-0223

CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 12/28/00

Date Made Active at EDR: 02/28/01

Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 12/29/00

Elapsed ASTM days: 61

Date of Last EDR Contact: 03/26/01

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned

Source: EPA

Telephone: 703-413-0223

As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 12/28/00

Date Made Active at EDR: 02/28/01

Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 12/29/00

Elapsed ASTM days: 61

Date of Last EDR Contact: 03/26/01

CORRACTS: Corrective Action Report

Source: EPA

Telephone: 800-424-9346

CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 04/20/00
Date Made Active at EDR: 08/01/00
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 06/12/00
Elapsed ASTM days: 50
Date of Last EDR Contact: 03/14/01

RCRIS: Resource Conservation and Recovery Information System

Source: EPA/NTIS
Telephone: 800-424-9346

Resource Conservation and Recovery Information System. RCRIS includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA).

Date of Government Version: 06/21/00
Date Made Active at EDR: 07/31/00
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 07/10/00
Elapsed ASTM days: 21
Date of Last EDR Contact: 01/30/01

ERNS: Emergency Response Notification System

Source: EPA/NTIS
Telephone: 202-260-2342

Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 08/08/00
Date Made Active at EDR: 09/06/00
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 08/11/00
Elapsed ASTM days: 26
Date of Last EDR Contact: 04/19/01

FEDERAL ASTM SUPPLEMENTAL RECORDS

BRS: Biennial Reporting System

Source: EPA/NTIS
Telephone: 800-424-9346

The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/97
Database Release Frequency: Biennially

Date of Last EDR Contact: 03/19/01
Date of Next Scheduled EDR Contact: 06/18/01

CONSENT: Superfund (CERCLA) Consent Decrees

Source: EPA Regional Offices
Telephone: Varies

Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: N/A
Database Release Frequency: Varies

Date of Last EDR Contact: N/A
Date of Next Scheduled EDR Contact: N/A

ROD: Records Of Decision

Source: NTIS
Telephone: 703-416-0223

Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 09/30/99
Database Release Frequency: Annually

Date of Last EDR Contact: 04/10/01
Date of Next Scheduled EDR Contact: 07/09/01

DELISTED NPL: National Priority List Deletions

Source: EPA
Telephone: N/A

The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 01/23/01
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/05/01
Date of Next Scheduled EDR Contact: 05/07/01

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report

Source: EPA
Telephone: N/A

Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 07/07/00
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/09/01
Date of Next Scheduled EDR Contact: 07/09/01

HMIRS: Hazardous Materials Information Reporting System

Source: U.S. Department of Transportation
Telephone: 202-366-4526

Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 05/31/00
Database Release Frequency: Annually

Date of Last EDR Contact: 04/24/01
Date of Next Scheduled EDR Contact: 07/23/01

MLTS: Material Licensing Tracking System

Source: Nuclear Regulatory Commission
Telephone: 301-415-7169

MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 01/30/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 04/09/01
Date of Next Scheduled EDR Contact: 07/09/01

MINES: Mines Master Index File

Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959

Date of Government Version: 08/01/98
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 04/02/01
Date of Next Scheduled EDR Contact: 07/02/01

NPL LIENS: Federal Superfund Liens

Source: EPA
Telephone: 205-564-4267

Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 02/20/01
Date of Next Scheduled EDR Contact: 05/21/01

PADS: PCB Activity Database System

Source: EPA
Telephone: 202-260-3936

PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 01/01/00
Database Release Frequency: Annually

Date of Last EDR Contact: 02/12/01
Date of Next Scheduled EDR Contact: 05/14/01

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

RAATS: RCRA Administrative Action Tracking System

Source: EPA

Telephone: 202-564-4104

RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95

Database Release Frequency: No Update Planned

Date of Last EDR Contact: 03/13/01

Date of Next Scheduled EDR Contact: 06/11/01

TRIS: Toxic Chemical Release Inventory System

Source: EPA

Telephone: 202-260-1531

Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/97

Database Release Frequency: Annually

Date of Last EDR Contact: 03/26/01

Date of Next Scheduled EDR Contact: 06/25/01

TSCA: Toxic Substances Control Act

Source: EPA

Telephone: 202-260-1444

Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/98

Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 03/30/01

Date of Next Scheduled EDR Contact: 06/12/01

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

Source: EPA/Office of Prevention, Pesticides and Toxic Substances

Telephone: 202-564-2501

FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 08/30/00

Database Release Frequency: Quarterly

Date of Last EDR Contact: 03/26/01

Date of Next Scheduled EDR Contact: 06/25/01

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)

Source: EPA

Telephone: 202-564-2501

Date of Government Version: 08/10/00

Database Release Frequency: Quarterly

Date of Last EDR Contact: 03/26/01

Date of Next Scheduled EDR Contact: 06/25/01

STATE OF MICHIGAN ASTM STANDARD RECORDS

SHWS: Contaminated Sites

Source: Department of Environmental Quality

Telephone: 517-373-9541

State Hazardous Waste Sites. State hazardous waste site records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. Available information varies by state.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

Date of Government Version: 11/01/00
Date Made Active at EDR: 12/30/00
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 11/27/00
Elapsed ASTM days: 33
Date of Last EDR Contact: 02/26/01

SWF/LF: Solid Waste Facilities Database

Source: Department of Environmental Quality
Telephone: 517-335-4035

Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 08/01/00
Date Made Active at EDR: 09/14/00
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 08/08/00
Elapsed ASTM days: 37
Date of Last EDR Contact: 01/31/01

LUST: Leaking Underground Storage Tank Sites

Source: Department of Environmental Quality
Telephone: 517-335-3075

Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 01/12/01
Date Made Active at EDR: 04/04/01
Database Release Frequency: Annually

Date of Data Arrival at EDR: 03/08/01
Elapsed ASTM days: 27
Date of Last EDR Contact: 02/22/01

UST: Underground Storage Tank Facility List

Source: Department of Environmental Quality
Telephone: 517-373-8168

Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 01/02/01
Date Made Active at EDR: 04/06/01
Database Release Frequency: Annually

Date of Data Arrival at EDR: 03/08/01
Elapsed ASTM days: 29
Date of Last EDR Contact: 02/22/01

STATE OF MICHIGAN ASTM SUPPLEMENTAL RECORDS

AST: Aboveground Tanks

Source: Department of Environmental Quality
Telephone: 517-373-8168
Registered Aboveground Storage Tanks.

Date of Government Version: 01/02/01
Database Release Frequency: Annually

Date of Last EDR Contact: 02/22/01
Date of Next Scheduled EDR Contact: 06/18/01

EDR PROPRIETARY DATABASES

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. ©Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

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The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

HISTORICAL AND OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Oil/Gas Pipelines/Electrical Transmission Lines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines and electrical transmission lines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 1999 from the U.S. Fish and Wildlife Service.

GEOCHECK[®] - PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

USCG DETROIT ATWATER PROPERTY
2660 E. ATWATER ST
DETROIT, MI 48207

TARGET PROPERTY COORDINATES

Latitude (North):	42.335300 - 42° 20' 7.1"
Longitude (West):	83.019203 - 83° 1' 9.1"
Universal Transverse Mercator:	Zone 17
UTM X (Meters):	333647.5
UTM Y (Meters):	4688766.0

EDR's GeoCheck Physical Setting Source Addendum has been developed to assist the environmental professional with the collection of physical setting source information in accordance with ASTM 1527-00, Section 7.2.3. Section 7.2.3 requires that a current USGS 7.5 Minute Topographic Map (or equivalent, such as the USGS Digital Elevation Model) be reviewed. It also requires that one or more additional physical setting sources be sought when (1) conditions have been identified in which hazardous substances or petroleum products are likely to migrate to or from the property, and (2) more information than is provided in the current USGS 7.5 Minute Topographic Map (or equivalent) is generally obtained, pursuant to local good commercial or customary practice, to assess the impact of migration of recognized environmental conditions in connection with the property. Such additional physical setting sources generally include information about the topographic, hydrologic, hydrogeologic, and geologic characteristics of a site, and wells in the area.

Assessment of the impact of contaminant migration generally has two principle investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata. EDR's GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

USGS TOPOGRAPHIC MAP ASSOCIATED WITH THIS SITE

Target Property: 2442083-C1 DETROIT, MI CA08
Source: USGS 7.5 min quad index

GENERAL TOPOGRAPHIC GRADIENT AT TARGET PROPERTY

Target Property: General SSE

Source: General Topographic Gradient has been determined from the USGS 1 Degree Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County
WAYNE, MI

FEMA Q3 Flood
Data Electronic Coverage
YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property:
Additional Panels in search area:

2602220035B / CBPP
Not Reported

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property
DETROIT

NWI Electronic
Coverage
NO

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Site-Specific Hydrogeological Data*:

Search Radius: 2.0 miles
Status: Not found

AQUIFLOW®

Search Radius: 2.000 Miles.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
1	0 - 1/8 Mile ENE	Not Reported
A2	1/2 - 1 Mile WSW	NE
A3	1/2 - 1 Mile WSW	NE
4	1/2 - 1 Mile WSW	Varies
5	1/2 - 1 Mile WSW	NE
B6	1 - 2 Miles WSW	NW
B7	1 - 2 Miles WSW	Not Reported

For additional site information, refer to Physical Setting Source Map Findings.

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

GEOLOGIC AGE IDENTIFICATION

Geologic Code: D2
Era: Paleozoic
System: Devonian
Series: Middle Devonian

ROCK STRATIGRAPHIC UNIT

Category: Stratified Sequence

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

* ©1996 Site-specific hydrogeological data gathered by CERCLIS Alerts, Inc., Bainbridge Island, WA. All rights reserved. All of the information and opinions presented are those of the cited EPA report(s), which were completed under a Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) investigation.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Component Name: URBANLAND

Soil Surface Texture: variable

Hydrologic Group: Not reported

Soil Drainage Class: Not reported

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel: Not Reported

Depth to Bedrock Min: > 0 inches

Depth to Bedrock Max: > 0 inches

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	60 inches	variable	Not reported	Not reported	Max: 0.00 Min: 0.00	Max: 0.00 Min: 0.00

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: clay loam
loamy fine sand
loamy sand

Surficial Soil Types: clay loam
loamy fine sand
loamy sand

Shallow Soil Types: sand
silty clay

Deeper Soil Types: silt loam
sand
clay loam
silty clay

ADDITIONAL ENVIRONMENTAL RECORD SOURCES

According to ASTM E 1527-00, Section 7.2.2, "one or more additional state or local sources of environmental records may be checked, in the discretion of the environmental professional, to enhance and supplement federal and state sources... Factors to consider in determining which local or additional state records, if any, should be checked include (1) whether they are reasonably ascertainable, (2) whether they are sufficiently useful, accurate, and complete in light of the objective of the records review (see 7.1.1), and (3) whether they are obtained, pursuant to local, good commercial or customary practice." One of the record sources listed in Section 7.2.2 is water well information. Water well information can be used to assist the environmental professional in assessing sources that may impact groundwater flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

WELL SEARCH DISTANCE INFORMATION

<u>DATABASE</u>	<u>SEARCH DISTANCE (miles)</u>
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile
State Database	1.000

FEDERAL USGS WELL INFORMATION

<u>MAP ID</u>	<u>WELL ID</u>	<u>LOCATION FROM TP</u>
No Wells Found		

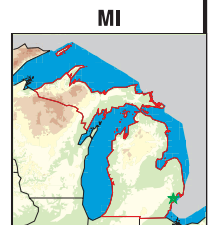
FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

<u>MAP ID</u>	<u>WELL ID</u>	<u>LOCATION FROM TP</u>
No PWS System Found		

Note: PWS System location is not always the same as well location.

STATE DATABASE WELL INFORMATION

<u>MAP ID</u>	<u>WELL ID</u>	<u>LOCATION FROM TP</u>
No Wells Found		

[illegible]

- Legend:

 - Major Roads
 - Contour Lines
 - Water Wells
 - Public Water Supply Wells
 - Groundwater Flow Direction
 - Indeterminate Groundwater Flow at Location
 - Groundwater Flow Varies at Location
 - Cluster of Multiple Icons
 - Earthquake epicenter, Richter 5 or greater
 - Closest Hydrogeological Data
 - Oil, gas or related wells

TARGET PROPERTY: USCG Detroit Atwater Property
ADDRESS: 2660 E. Atwater St
CITY/STATE/ZIP: Detroit MI 48207
LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
CONTACT: Robert Davis
INQUIRY #: 625908.4s
DATE: May 01, 2001 10:48 am

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID
Direction
Distance
Elevation

Database EDR ID Number

1 ENE 0 - 1/8 Mile Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	826740 Not Reported 1 3 2 02/20/1995	AQUIFLOW	34936
A2 WSW 1/2 - 1 Mile Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	826884 NE 1 5.5 Not Reported 07/08/1991	AQUIFLOW	34943
A3 WSW 1/2 - 1 Mile Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	826561 NE 1 5.5 Not Reported 07/08/1991	AQUIFLOW	34944
4 WSW 1/2 - 1 Mile Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	820663 Varies 1 3.5 Not Reported 02/28/1995	AQUIFLOW	35327
5 WSW 1/2 - 1 Mile Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	820077 NE 2 3 Not Reported 06/05/1998	AQUIFLOW	35417
B6 WSW 1 - 2 Miles Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	820638 NW .5 11 Not Reported 03/1996	AQUIFLOW	35395
B7 WSW 1 - 2 Miles Higher	Site ID: Groundwater Flow: Shallowest Water Table Depth: Deepest Water Table Depth: Average Water Table Depth: Date:	826272 Not Reported 8 9 Not Reported 10/1996	AQUIFLOW	35006

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS RADON

AREA RADON INFORMATION

Federal EPA Radon Zone for WAYNE County: 3

Note: Zone 1 indoor average level > 4 pCi/L.

: Zone 2 indoor average level ≥ 2 pCi/L and ≤ 4 pCi/L.

: Zone 3 indoor average level < 2 pCi/L.

Zip Code: 48207

Number of sites tested: 1

Area	Average Activity	% <4 pCi/L	% 4-20 pCi/L	% >20 pCi/L
Living Area - 1st Floor	Not Reported	Not Reported	Not Reported	Not Reported
Living Area - 2nd Floor	Not Reported	Not Reported	Not Reported	Not Reported
Basement	1.300 pCi/L	100%	0%	0%

PHYSICAL SETTING SOURCE RECORDS SEARCHED

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 1999 from the U.S. Fish and Wildlife Service.

HYDROGEOLOGIC INFORMATION

AQUIFLOW^R Information System

Source: EDR proprietary database of groundwater flow information

EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit

Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the national Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

ADDITIONAL ENVIRONMENTAL RECORD SOURCES

FEDERAL WATER WELLS

PWS: Public Water Systems

Source: EPA/Office of Drinking Water

Telephone: 202-260-2805

Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data

Source: EPA/Office of Drinking Water

Telephone: 202-260-2805

Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: In November 1971 the United States Geological Survey (USGS) implemented a national water resource information tracking system. This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on more than 900,000 wells, springs, and other sources of groundwater.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

STATE RECORDS

Michigan Public and Private Water Wells

Source: Michigan Department of Natural Resources

Locations of verified municipal and private water well sites compiled from Michigan Department of Public Health, Water Well and Pump Records. Available in the following MI counties: Calhoun, Eaton, Genesee, Ingham, Jackson, Kalamazoo, Kent, Midland, Muskegon, Oakland, Ottawaw, Saginaw, St. Clair, Washtenaw.

Michigan Oil and Gas Wells

Source: Michigan Department of Natural Resources

Locations of oil and gas wells are compiled from permit records on file at the Geological Survey Division (GSD), Michigan Department of Natural Resources.

RADON

Area Radon Information: The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones: Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Epicenters: World earthquake epicenters, Richter 5 or greater

Source: Department of Commerce, National Oceanic and Atmospheric Administration



EDR NEPA Check®

**USCG Detroit Atwater Property
2660 E. Atwater St
Detroit, MI 48207**

Inquiry Number: 625908.2s

May 01, 2001

***The Source
For Environmental
Risk Management
Data***

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

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Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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EDR NEPACheck® DESCRIPTION

The National Environmental Policy Act of 1969 (NEPA) requires that Federal agencies include in their decision-making processes appropriate and careful consideration of all environmental effects and actions, analyze potential environmental effects of proposed actions and their alternatives for public understanding and scrutiny, avoid or minimize adverse effects of proposed actions, and restore and enhance environmental quality as much as possible.

The EDR NEPACheck provides information which may be used, in conjunction with additional research, to determine whether a proposed site or action will have significant environmental effect.

The report provides maps and data for the following NEPA checklist items for geographic areas which are available in electronic format:

Natural Areas Map

- Federal Lands Data:
 - Officially designated wilderness areas
 - Officially designated wildlife preserves, sanctuaries and refuges
 - Wild and scenic rivers
 - Fish and Wildlife
- Threatened or Endangered Species, Fish and Wildlife, Critical Habitat Data

Regulation

47 CFR 1.1307(1)
47 CFR 1.1307(2)

40 CFR 6.302(e)
40 CFR 6.302
47 CFR 1.1307(3); 40 CFR 6.302

Historic Places Map

- National Register of Historic Places

47 CFR 1.1307(4); 40 CFR 6.302

Flood Plain Map

- National Flood Plain Data

47 CFR 1.1307(6); 40 CFR 6.302

Wetlands Map

- National Wetlands Inventory Data

47 CFR 1.1307(7); 40 CFR 6.302

FCC & FAA Map

- FCC antenna/tower sites, AM Radio Towers, FAA Markings and Obstructions

47 CFR 1.1307(8)

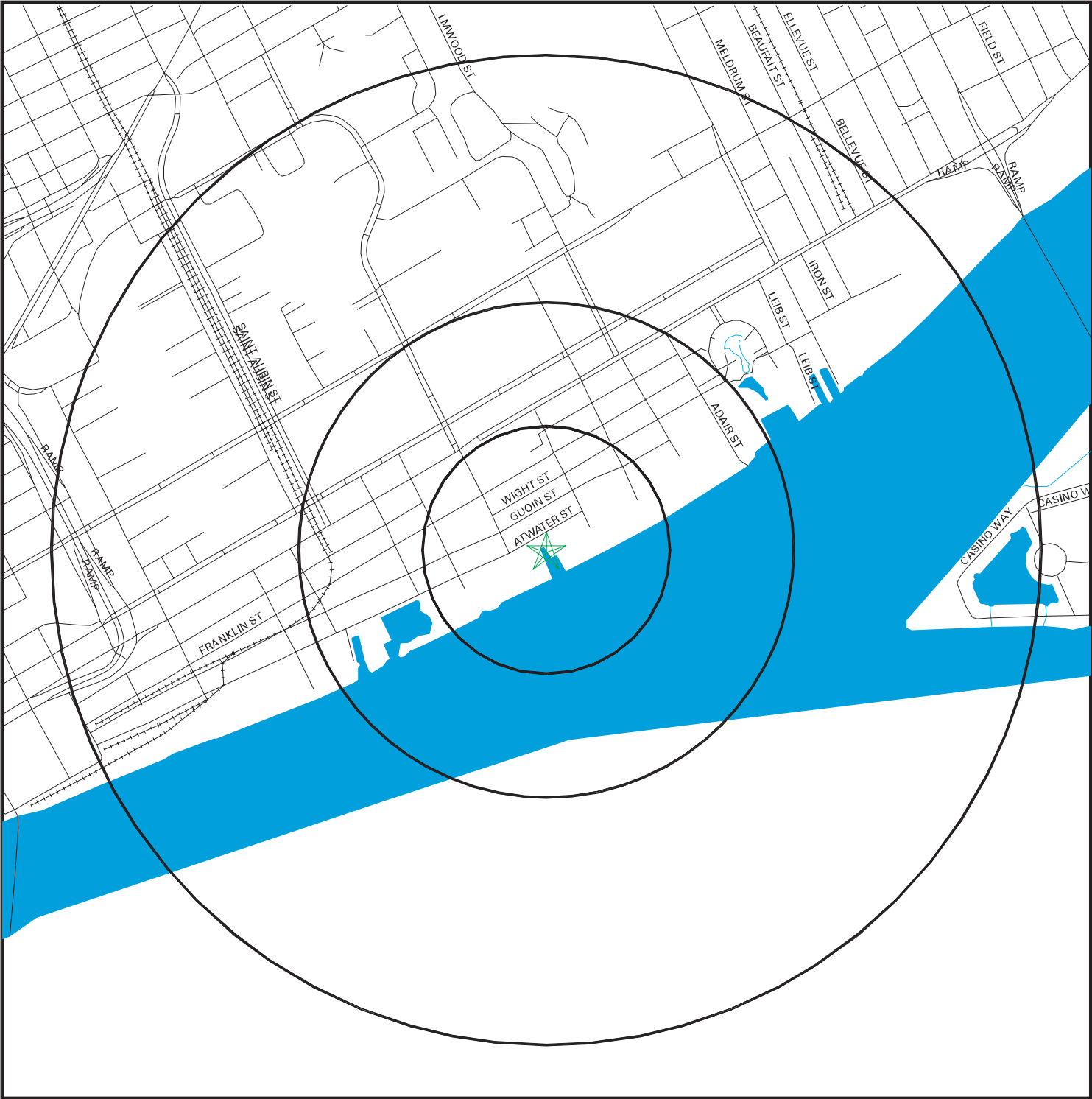
Key Contacts and Government Records Searched

MAP FINDINGS SUMMARY

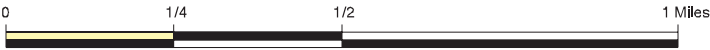
The databases searched in this report are listed below. Database descriptions and other agency contact information is contained in the Key Contacts and Government Records Searched section on page 37 of this report.

Database	Search Distance (Miles)	Item within Search Distance	Item within 1/8 mile of Target Property
Federal Lands	1.00	NO	NO
Facilities	1.00	NO	NO
NEPAHIST	1.00	YES	NO
FLOODPLAIN	1.00	YES	YES
NWI	1.00	NO	NO
FCC Cellular	1.00	YES	NO
FCC Antenna	1.00	NO	NO
FCC Tower	1.00	YES	NO
FCC AM Tower	1.00	NO	NO
FAA DOF	1.00	YES	YES

Natural Areas Map



- ★ Target Property
- ⚡ Roads
- ⚡ Waterways
- ⛶ State Natural/Wildlife Locations
- ⚡ State Natural/Wildlife Linear Features
- ⛶ Federal Natural/Wildlife Linear Features
- ▨ State Natural/Wildlife Areas
- ▨ Federal Natural/Wildlife Areas



TARGET PROPERTY:	USCG Detroit Atwater Property	CUSTOMER:	Tetra Tech NUS, Inc.
ADDRESS:	2660 E. Atwater St	CONTACT:	Robert Davis
CITY/STATE/ZIP:	Detroit MI 48207	INQUIRY #:	625908.2s
LAT/LONG:	42.3353 / 83.0192	DATE:	May 01, 2001

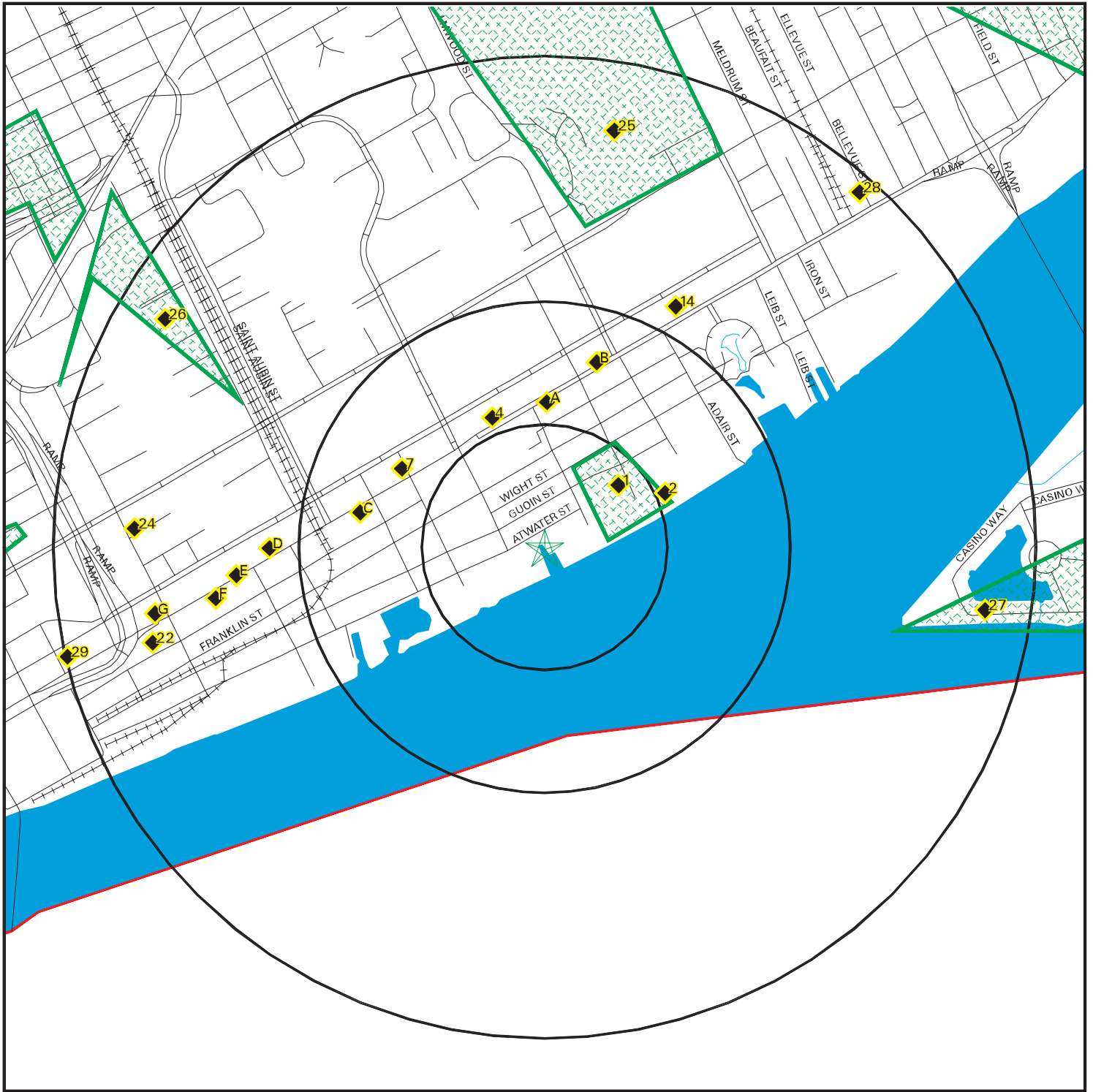
NATURAL AREAS MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.) Site

EDR ID
Database

No Sites Reported.

Historic Places Map



-  Streets
-  Waterways
-  Water
-  Historic Sites
-  Historic Areas
-  Scenic Trail



TARGET PROPERTY: USCG Detroit Atwater Property
 ADDRESS: 2660 E. Atwater St
 CITY/STATE/ZIP: Detroit MI 48207
 LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
 CONTACT: Robert Davis
 INQUIRY #: 625908.2s
 DATE: May 01, 2001

HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

1 NE 1/8-1/4 mi 1038	Resource Name: Parke-Davis and Company Pharmaceutical Company Plant Alternate Name: Not Reported Resource Address: Bounded by Joseph Campau Ave., Wight St., and McDougal Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19850916 Acreage: 160 Number of Buildings: 7 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 2 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Industry, Science, Architecture, Invention Current Function: Work in progress Building Material: None listed, Brick, Stone, Concrete Other Names: River Place Complex; See Also: Parke-Davis Research Laboratory	85002445 NEPAHIST
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2 ENE 1/4-1/2 mi 1421	Resource Name: Parke-Davis Research Laboratory Alternate Name: Not Reported Resource Address: Joseph Campau St. at Detroit River Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19760511 Acreage: 10 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event Areas of Significance: Science Current Function: Education Building Material: None listed, Brick Other Names: Building 55--Detroit Research	76001039 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

A3 North 1/4-1/2 mi 1472	Resource Name: Walker, Franklin H., House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2730 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Health care Building Material: None listed, Brick, Limestone, Ceramic tile Other Names: Doctor's Hospital	85002948 NEPAHIST
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4 NNW 1/4-1/2 mi 1499	Resource Name: Chene, Alexander, House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2681 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Exploration/settlement, Architecture Current Function: Commerce/trade Building Material: None listed, Brick, Iron Other Names: Little Harry's Restaurant	85002936 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

A5 North 1/4-1/2 mi 1570	Resource Name: Garden Court Apartments Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2900 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic Building Material: None listed, Brick, Limestone	85002937 NEPAHIST
-----------------------------------	---	----------------------

A6 North 1/4-1/2 mi 1646	Resource Name: Campau, Joseph, House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2910 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Exploration/settlement, Architecture Current Function: Domestic Building Material: None listed	85002935 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

7 WNW 1/4-1/2 mi 1748	Resource Name: McMillan, Philip, House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2201 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Determined eligible/owner objection Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Health care Building Material: None listed, Brick, Stone	85003606 NEPAHIST
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B8 NNE 1/4-1/2 mi 1882	Resource Name: Osborn, Frank A., House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 1920 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Determined eligible/owner objection Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Commerce/trade Building Material: None listed, Brick, Stone Other Names: Osborn House	85003607 NEPAHIST
---------------------------------	--	----------------------

HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

C9 WNW 1/4-1/2 mi 1911	Resource Name: Pasadena Apartments Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2170 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic Building Material: None listed, Brick, Limestone	85002944 NEPAHIST
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B10 NNE 1/4-1/2 mi 2102	Resource Name: Bagley, John N., House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2921 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Education Building Material: None listed, Brick, Sandstone Other Names: Bagley House	85002934 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

C11 West 1/4-1/2 mi 2126	Resource Name: Manchester Apartments Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2016 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic Building Material: None listed, Brick, Stone	85002941 NEPAHIST
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B12 NNE 1/4-1/2 mi 2214	Resource Name: Wells, William H., House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 2931 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 2 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Education Building Material: None listed, Weatherboard, Brick, Stone Other Names: Wells House	85002949 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

D13 West 1/2-1 mi 2859	Resource Name: Somerset Apartments Alternate Name: East Jefferson Avenue Residential TR Resource Address: 1523 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic Building Material: None listed, Brick, Limestone Other Names: Parkcrest Apartment Building	85002946 NEPAHIST
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14 NNE 1/2-1 mi 2948	Resource Name: Players, The Alternate Name: Not Reported Resource Address: 3321 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19870612 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Architecture, Social history Current Function: Recreation and culture, Social Building Material: None listed, Brick, Stone, Concrete	87000920 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

D15 West 1/2-1 mi 3052	Resource Name: Jefferson Hall Alternate Name: East Jefferson Avenue Residential TR Resource Address: 1405 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic, Commerce/trade Building Material: None listed, Brick, Stone	85002939 NEPAHIST
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E16 West 1/2-1 mi 3251	Resource Name: Moross House Alternate Name: Not Reported Resource Address: 1460 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19720113 Acreage: 10 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Work in progress Building Material: None listed, Wood, Brick, Limestone, Metal	72000669 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

E17 West 1/2-1 mi 3256	Resource Name: Thayer, Ella, House Alternate Name: East Jefferson Avenue Residential TR Resource Address: 1386 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Determined eligible/owner objection Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Commerce/trade Building Material: None listed, Brick, Stone	85003608 NEPAHIST
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E18 West 1/2-1 mi 3465	Resource Name: Ponchartrain Apartments Alternate Name: East Jefferson Avenue Residential TR Resource Address: 1350 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Community planning and development, Architecture Current Function: Vacant/not in use Building Material: None listed, Brick, Limestone Other Names: Renaissance Apartments	85002945 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

F19 West 1/2-1 mi 3478	Resource Name: Croul-Palms House Alternate Name: Not Reported Resource Address: 1394 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19831220 Acreage: 5 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering, Person Areas of Significance: Commerce, Architecture Current Function: Commerce/trade Building Material: None listed, Wood, Brick, Stone	83003790 NEPAHIST
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F20 West 1/2-1 mi 3672	Resource Name: Trowbridge, Charles, House Alternate Name: Not Reported Resource Address: 1380 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19760528 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Person Areas of Significance: Commerce, Politics/government Current Function: Domestic Building Material: None listed, Brick	76001042 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

G21 West 1/2-1 mi 4141	Resource Name: Palms, The Alternate Name: East Jefferson Avenue Residential TR Resource Address: 1001 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19851009 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic Building Material: None listed, Limestone	85002942 NEPAHIST
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22 WSW 1/2-1 mi 4333	Resource Name: Christ Church, Detroit Alternate Name: Not Reported Resource Address: 960 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19710311 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture, Religion Current Function: Religion Building Material: None listed, Sandstone, Limestone, Slate Other Names: Old Christ Church, Detroit	71000423 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

G23 West 1/2-1 mi 4350	Resource Name: Parker, Thomas A., House Alternate Name: Not Reported Resource Address: 975 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19821112 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Domestic, Commerce/trade Building Material: Brick, Stone, Slate Other Names: Parker House	82000552 NEPAHIST
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24 West 1/2-1 mi 4409	Resource Name: Sibley House Alternate Name: Not Reported Resource Address: 976 Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19710416 Acreage: 9 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Religion Building Material: None listed Other Names: Rectory of Christ Church	71000432 NEPAHIST
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HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

25 North 1/2-1 mi	Resource Name: Eastside Historic Cemetery District Alternate Name: Not Reported Resource Address: Bounded by Elmwood and Mt. Elliot Aves., Lafayette and Waterloo Sts.	82000550 NEPAHIST
4540	Resource Type: District Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19821202 Acreage: 1300 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 2 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Landscape architecture, Art, Architecture, Religion Current Function: Funerary Building Material: None listed, Brick, Stone Other Names: East Side Historic Cemetary District	

26 WNW 1/2-1 mi	Resource Name: Mies van der Rohe Residential District, Lafayette Park Alternate Name: Not Reported Resource Address: Roughly bounded by Lafayette Ave., Rivard, Antietam, and Orleans Sts.	96000809 NEPAHIST
4755	Resource Type: District Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19960801 Acreage: 460 Number of Buildings: 26 Number of Objects: 0 Number of Sites: 1 Num. of Structures: 0 Number of non-contributing Buildings: 1 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Architecture, Community planning and development Current Function: Domestic Building Material: Brick, Aluminum, Steel, Asphalt, Concrete, Glass	

HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

27 East 1/2-1 mi 4784	Resource Name: Belle Isle Alternate Name: Not Reported Resource Address: Detroit River Resource Type: District Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19740225 Acreage: 9820 Number of Buildings: 39 Number of Objects: 10 Number of Sites: 0 Num. of Structures: 16 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 2 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering Areas of Significance: Landscape architecture, Science, Architecture Current Function: Recreation and culture, Landscape Building Material: Wood, Weatherboard, Brick, Stone, Iron, Glass Other Names: Wah-na-be-zee(Swan Island), Isle Au Cochon(Hog Island)	74000999 NEPAHIST
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28 NE 1/2-1 mi 5101	Resource Name: Stearns, Frederick, Building Alternate Name: Not Reported Resource Address: 6533 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19801014 Acreage: 30 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Event, Architecture/Engineering, Person Areas of Significance: Industry, Commerce, Architecture Current Function: Commerce/trade, Work in progress Building Material: None listed, Brick, Stone, Limestone	80001927 NEPAHIST
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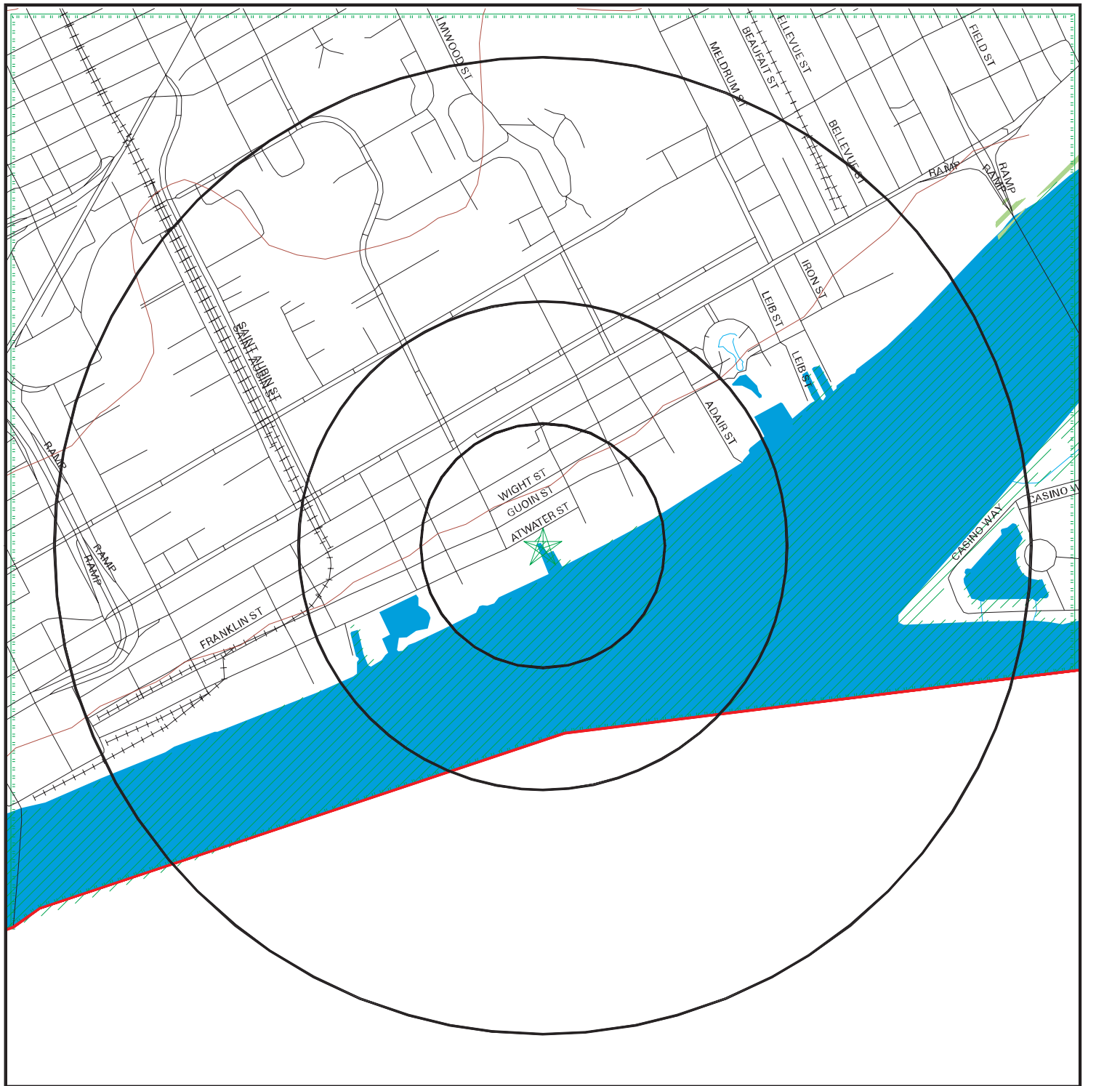
HISTORIC PLACES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

29 WSW 1/2-1 mi 5258	Resource Name: Saints Peter And Paul Church Alternate Name: Not Reported Resource Address: 629 E. Jefferson Ave. Resource Type: Building Location: Detroit, MI County: Wayne, MI Primary Certification: Listed in the national register Certification Date: 19710903 Acreage: 20 Number of Buildings: 1 Number of Objects: 0 Number of Sites: 0 Num. of Structures: 0 Number of non-contributing Buildings: 0 Number of non-contributing Objects: 0 Number of non-contributing Sites: 0 Num. of non-contributing Structures: 0 Applicable Criteria: Architecture/Engineering Areas of Significance: Architecture Current Function: Religion Building Material: None listed, Brick, Stone, Metal	71000431 NEPAHIST
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Flood Plain Map



Major Roads
Contour Lines
Waterways
County Boundary

Power Lines
Pipe Lines
Fault Lines

Water
100-year flood zone
500-year flood zone
Electronic FEMA data available
Electronic FEMA data not available

0 1/4 1/2 1 Miles



TARGET PROPERTY: USCG Detroit Atwater Property
ADDRESS: 2660 E. Atwater St
CITY/STATE/ZIP: Detroit MI 48207
LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
CONTACT: Robert Davis
INQUIRY #: 625908.2s
DATE: May 01, 2001

FLOOD PLAIN MAP FINDINGS

Source: FEMA Q3 Flood Data

County

FEMA flood data electronic coverage

WAYNE, MI

YES

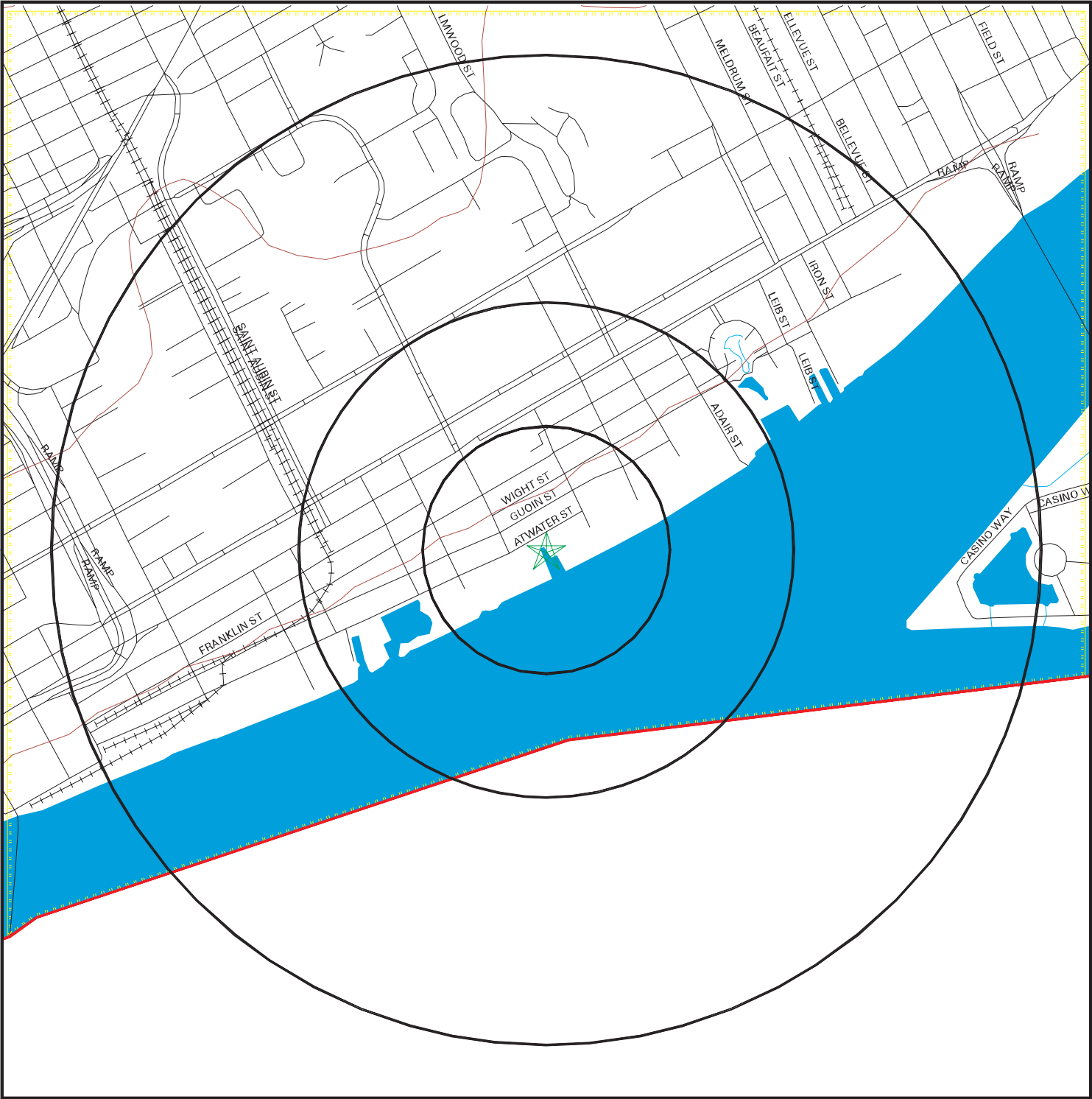
Flood Plain panel at target property:

2602220035B / CBPP

Additional Flood Plain panel(s) in search area:

None Reported

National Wetlands Inventory Map



Major Roads
Contour Lines
Waterways
County Boundary

Power Lines
Pipe Lines
Fault Lines

Water
Wetlands
Electronic NWI data available
Electronic NWI data not available

0 1/4 1/2 1 Miles



TARGET PROPERTY: USCG Detroit Atwater Property
ADDRESS: 2660 E. Atwater St
CITY/STATE/ZIP: Detroit MI 48207
LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
CONTACT: Robert Davis
INQUIRY #: 625908.2s
DATE: May 01, 2001

WETLANDS MAP FINDINGS

Source: Fish and Wildlife Service NWI data

NWI hardcopy map at target property: Detroit

Additional NWI hardcopy map(s) in search area:
Belle Isle

Map ID

Direction

Distance

Distance (ft.)

Code and Description*

Database

No Sites Reported.

*See Wetland Classification System for additional information.

WETLANDS CLASSIFICATION SYSTEM

National Wetland Inventory Maps are produced by the U.S. Fish and Wildlife Service, a sub-department of the U.S. Department of the Interior. In 1974, the U.S. Fish and Wildlife Service developed a criteria for wetland classification with four long range objectives:

- to describe ecological units that have certain homogeneous natural attributes,
- to arrange these units in a system that will aid decisions about resource management,
- to furnish units for inventory and mapping, and
- to provide uniformity in concepts and terminology throughout the U.S.

High altitude infrared photographs, soil maps, topographic maps and site visits are the methods used to gather data for the productions of these maps. In the infrared photos, wetlands appear as different colors and these wetlands are then classified by type. Using a hierarchical classification, the maps identify wetland and deepwater habitats according to:

- system
- subsystem
- class
- subclass
- modifiers

(as defined by Cowardin, et al. U.S. Fish and Wildlife Service FWS/OBS 79/31. 1979.)

The classification system consists of five systems:

1. marine
2. estuarine
3. riverine
4. lacustrine
5. palustrine

The marine system consists of deep water tidal habitats and adjacent tidal wetlands. The riverine system consists of all wetlands contained within a channel. The lacustrine systems includes all nontidal wetlands related to swamps, bogs & marshes. The estuarine system consists of deepwater tidal habitats and where ocean water is diluted by fresh water. The palustrine system includes nontidal wetlands dominated by trees and shrubs and where salinity is below .5% in tidal areas. All of these systems are divided in subsystems and then further divided into class.

National Wetland Inventory Maps are produced by transferring gathered data on a standard 7.5 minute U.S.G.S. topographic map. Approximately 52 square miles are covered on a National Wetland Inventory map at a scale of 1:24,000. Electronic data is compiled by digitizing these National Wetland Inventory Maps.

SYSTEM

MARINE

SUBSYSTEM

1 - SUBTIDAL

2 - INTERTIDAL

CLASS	RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RF-REEF	OW-OPEN WATER / Unknown Bottom	AB-AQUATIC BED	RF-REEF	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 5 Unknown Submergent	1 Coral 3 Worm		1 Algal 3 Rooted Vascular 5 Unknown Submergent	1 Coral 3 Worm	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic

SYSTEM

E - ESTUARINE

SUBSYSTEM

1 - SUBTIDAL

CLASS	RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RF-REEF	OW-OPEN WATER / Unknown Bottom
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	2 Mollusk 3 Worm	

SUBSYSTEM

2 - INTERTIDAL

CLASS	AB-AQUATIC BED	RF-REEF	SB - STREAMBED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	EM-EMERGENT	SS-SCRUB SHRUB	FO-FORESTED
Subclass	1 Algal 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	2 Mollusk 3 Worm	1 Cobble- Gravel 2 Sand 3 Mud 4 Organic	1 Bedrock 2 Rubble	1 Cobble- Gravel 2 Sand 3 Mud 4 Organic	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen

SYSTEM

R - RIVERINE

SUBSYSTEM

1 - TIDAL	2 - LOWER PERENNIAL	3 - UPPER PERENNIAL	4 - INTERMITTENT	5 - UNKNOWN PERENNIAL			
RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	*SB-STREAMBED	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	**EM-EMERGENT	OW-OPEN WATER/ Unknown Bottom
1 Bedrock	1 Cobble-Gravel	1 Bedrock	1 Algal	1 Bedrock	1 Cobble-Gravel	2 Nonpersistent	
2 Rubble	2 Sand	2 Rubble	2 Aquatic Moss	2 Rubble	2 Sand		
	3 Mud	3 Cobble-Gravel	3 Rooted Vascular		3 Mud		
	4 Organic	4 Sand	4 Floating Vascular		4 Organic		
		5 Mud	5 Unknown Submergent		5 Vegetated		
		6 Organic	6 Unknown Surface				
		7 Vegetated					

* STREAMBED is limited to TIDAL and INTERMITTENT SUBSYSTEMS, and comprises the only CLASS in the INTERMITTENT SUBSYSTEM.

**EMERGENT is limited to TIDAL and LOWER PERENNIAL SUBSYSTEMS.

SYSTEM

L - LACUSTRINE

SUBSYSTEM

1 - LIMNETIC

	RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	OW-OPEN WATER/ Unknown Bottom
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	

SUBSYSTEM

2 - LITTORAL

	RB-ROCK BOTTOM	UB-UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	RS-ROCKY SHORE	US-UNCONSOLIDATED SHORE	EM-EMERGENT	OW-OPEN WATER/ Unknown Bottom
Subclass	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 Unknown Submergent 6 Unknown Surface	1 Bedrock 2 Rubble	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	2 Nonpersistent	

SUBSYSTEM

P - PALUSTRINE

CLASS	RB--ROCK BOTTOM	UB--UNCONSOLIDATED BOTTOM	AB-AQUATIC BED	US--UNCONSOLIDATED SHORE	ML--MOSS- LICHEN	EM--EMERGENT	SS--SCRUB-SHRUB	FO--FORESTED	OW-OPEN WATER/ Unknown
Bottom									
Subclass	1 Bedrock 2 Rubble 3 Mud 4 Organic	1 Cobble-Gravel 2 Sand	1 Algal 2 Aquatic Moss 3 Rooted Vascular 4 Floating Vascular 5 Unknown 6 Unknown Surface	1 Cobble-Gravel 2 Sand 3 Mud 4 Organic 5 Vegetated	1 Moss 2 Lichen	1 Persistent 2 Nonpersistent	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6 Deciduous 7 Evergreen	1 Broad-Leaved Deciduous 2 Needle-Leaved Deciduous 3 Broad-Leaved Evergreen 4 Needle-Leaved Evergreen 5 Dead 6Deciduous 7 Evergreen	

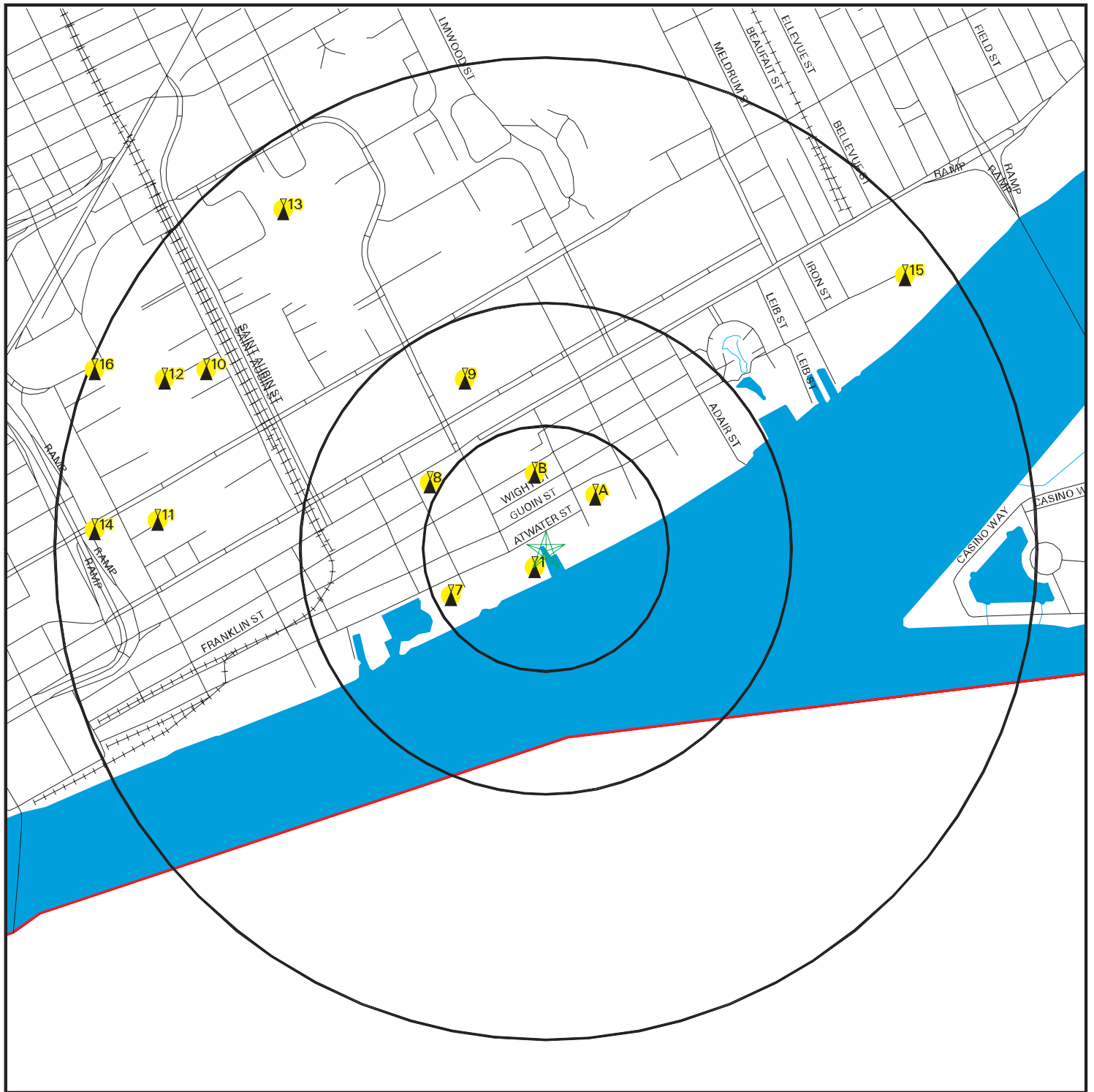
MODIFIERS

In order to more adequately describe wetland and deepwater habitats one or more of the water regime, water chemistry, soil, or special modifiers may be applied at the class or lower level in the hierarchy. The farmed modifier may also be applied to the ecological system.

WATER REGIME				WATER CHEMISTRY			SOIL	SPECIAL MODIFIERS
Non-Tidal	Tidal	Coastal	HalinityInlandSalinitypHModifiersfor	all Fresh Water				
A Temporarily Flooded	H Permanently Flooded	K Artificially Flooded	*S Temporary-Tidal	1 Hyperhaline	7 Hypersaline		g Organic	b Beaver
B Saturated	J Intermittently Flooded	L Subtidal	*R Seasonal-Tidal	2 Euhaline	8 Eusaline	a Acid	n Mineral	d Partially Drained/Ditched
C Seasonally Flooded	K Artificially Flooded	M Irregularly Exposed	*T Semipermanent -Tidal	3 Mixohaline (Brackish)	9 Mixosaline	t Circumneutral		f Farmed
D Seasonally Flooded/ Well Drained	W Intermittently Flooded/Temporary	N Regularly Flooded	V Permanent -Tidal	4 Polyhaline	0 Fresh	i Alkaline		h Diked/Impounded
E Seasonally Flooded/ Saturated	Y Saturated/Semipermanent/ Seasonal	P Irregularly Flooded	U Unknown	5 Mesohaline				r Artificial Substrate
F Semipermanently Flooded	Z Intermittently Exposed/Permanent	*These water regimes are only used in tidally influenced, freshwater systems.		6 Oligohaline				s Spoil
G Intermittently Exposed	U Unknown			0 Fresh				x Excavated

Source: U.S. Department of the Interior
Fish and Wildlife Service
National Wetlands Inventory

FCC & FAA Sites Map



-  Streets
-  Waterways
-  Water
-  Sites
-  Omni Directional AM Interference
-  Directional AM Interference



TARGET PROPERTY: USCG Detroit Atwater Property
 ADDRESS: 2660 E. Atwater St
 CITY/STATE/ZIP: Detroit MI 48207
 LAT/LONG: 42.3353 / 83.0192

CUSTOMER: Tetra Tech NUS, Inc.
 CONTACT: Robert Davis
 INQUIRY #: 625908.2s
 DATE: May 01, 2001

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

1			DOF000000037104
SSW			FAA DOF
0-1/8 mi			
230			
Unique ID:	230835	Obstruction #:	0835
City:	DETROIT	State:	Michigan
Verification Status:	verified	Obstruction Type:	BLDG
Latitude:	42 20 05N	Longitude:	083 01 11W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):			0215
Above Mean Sea Level Height (Ft.):			00795
Horizontal Accuracy:	+/-100'	Vertical Accuracy:	+/-20'
Painted/Marked:	No	FAA Study #:	Stereoplot

A2			CEL100000000670
NE			CELLULAR
1/8-1/4 mi			
703			
Low Frequency:	825.03000000	High Frequency:	834.99000000
Callsign:	KNKA244	Radio Code:	CL
DBA Name:	DETROIT CELLULAR TELEPHONE COMPANY		
Contact:	Not Reported		
Licensee:	DETROIT CELLULAR TELEPHONE COMPANY		
	Not Reported		
	FARMINGTON HILLS, MI 48108		
Transmitter Address:	300 RIVERPLACE		
	DETROIT, MI		
County:	WAYNE		
Latitude:	422012	Longitude:	0830103
Elevation:	00000	Height:	00000
Height Average:	00000	Effective Height:	00100
Structure Height:	00000	Class Code:	MO
ERP:	00000000	Database ID:	Y
License Date:	940923	Emissions:	40K0F3E 40K0F1D
Issue Date:	940831	Expiration Date:	941001
Mobile Vehicles:	Not Reported	Total Units:	Not Reported
Control Point Auth:	00	Authorization Type:	L

This record is for a license, and it may or may not indicate a site which has been built.

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

A3
NE
1/8-1/4 mi
703

CEL100000029371
CELLULAR

Low Frequency:	870.03000000	High Frequency:	879.99000000
Callsign:	KNKA244	Radio Code:	CL
DBA Name:	DETROIT CELLULAR TELEPHONE COMPANY		
Contact:	Not Reported		
Licensee:	DETROIT CELLULAR TELEPHONE COMPANY		
	Not Reported		
	FARMINGTON HILLS, MI 48108		
Transmitter Address:	300 RIVERPLACE		
	DETROIT, MI		
County:	WAYNE		
Latitude:	422012	Longitude:	0830103
Elevation:	00000	Height:	00000
Height Average:	00000	Effective Height:	00100
Structure Height:	00000	Class Code:	FB
ERP:	00000000	Database ID:	Y
License Date:	940923	Emissions:	40K0F3E 40K0F1D
Issue Date:	940831	Expiration Date:	941001
Mobile Vehicles:	Not Reported	Total Units:	Not Reported
Control Point Auth:	00	Authorization Type:	L

This record is for a license, and it may or may not indicate a site which has been built.

B4
North
1/8-1/4 mi
824

CEL100000042484
CELLULAR

Low Frequency:	880.02000000	High Frequency:	889.98000000
Callsign:	KNKA231	Radio Code:	CL
DBA Name:	DETROIT SMSA LIMITED PARTNERSHIP		
Contact:	Not Reported		
Licensee:	DETROIT SMSA LIMITED PARTNERSHIP		
	Not Reported		
	HOFFMAN ESTATES, IL 601955000		
Transmitter Address:	300 RIVERSIDE PLAZA		
	DETROIT, MI		
County:	WAYNE		
Latitude:	422015	Longitude:	0830111
Elevation:	00000	Height:	00000
Height Average:	00000	Effective Height:	00120
Structure Height:	00120	Class Code:	FB
ERP:	00000000	Database ID:	Y
License Date:	940926	Emissions:	40K0F3E 40K0F1D
Issue Date:	940825	Expiration Date:	931001
Mobile Vehicles:	Not Reported	Total Units:	Not Reported
Control Point Auth:	00	Authorization Type:	L

This record is for a license, and it may or may not indicate a site which has been built.

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

B5
North
1/8-1/4 mi
824

CEL100000017600
CELLULAR

Low Frequency:	835.02000000	High Frequency:	844.98000000
Callsign:	KNKA231	Radio Code:	CL
DBA Name:	DETROIT SMSA LIMITED PARTNERSHIP		
Contact:	Not Reported		
Licensee:	DETROIT SMSA LIMITED PARTNERSHIP		
	Not Reported		
	HOFFMAN ESTATES, IL 601955000		
Transmitter Address:	300 RIVERSIDE PLAZA		
	DETROIT, MI		
County:	WAYNE		
Latitude:	422015	Longitude:	0830111
Elevation:	00000	Height:	00000
Height Average:	00000	Effective Height:	00120
Structure Height:	00120	Class Code:	MO
ERP:	00000000	Database ID:	Y
License Date:	940926	Emissions:	40K0F3E 40K0F1D
Issue Date:	940825	Expiration Date:	931001
Mobile Vehicles:	Not Reported	Total Units:	Not Reported
Control Point Auth:	00	Authorization Type:	L

This record is for a license, and it may or may not indicate a site which has been built.

A6
NE
1/8-1/4 mi
954

DOF000000037105
FAA DOF

Unique ID:	230836	Obstruction #:	0836
City:	DETROIT	State:	Michigan
Verification Status:	verified	Obstruction Type:	STACK
Latitude:	42 20 14N	Longitude:	083 01 01W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):	0205		
Above Mean Sea Level Height (Ft.):	00787		
Horizontal Accuracy:	+500'	Vertical Accuracy:	+50'
Painted/Marked:	Not Reported	FAA Study #:	Letter Reported

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

7
WSW
1/8-1/4 mi
1136

DOF000000038128
FAA DOF

Unique ID:	236180	Obstruction #:	6180
City:	DETROIT	State:	Michigan
Verification Status:	unverified	Obstruction Type:	BLDG
Latitude:	42 20 02N	Longitude:	083 01 23W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):			0174
Above Mean Sea Level Height (Ft.):			00759
Horizontal Accuracy:	Not Reported	Vertical Accuracy:	Not Reported
Painted/Marked:	Not Reported	FAA Study #:	Not Reported

8
WNW
1/4-1/2 mi
1436

DOF000000038129
FAA DOF

Unique ID:	236181	Obstruction #:	6181
City:	DETROIT	State:	Michigan
Verification Status:	unverified	Obstruction Type:	BLDG
Latitude:	42 20 14N	Longitude:	083 01 26W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):			0158
Above Mean Sea Level Height (Ft.):			00755
Horizontal Accuracy:	Not Reported	Vertical Accuracy:	Not Reported
Painted/Marked:	No	FAA Study #:	Telephone Reported

9
NNW
1/4-1/2 mi
2024

DOF000000038130
FAA DOF

Unique ID:	236182	Obstruction #:	6182
City:	DETROIT	State:	Michigan
Verification Status:	unverified	Obstruction Type:	BLDG
Latitude:	42 20 25N	Longitude:	083 01 21W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):			0187
Above Mean Sea Level Height (Ft.):			00786
Horizontal Accuracy:	Not Reported	Vertical Accuracy:	Not Reported
Painted/Marked:	Not Reported	FAA Study #:	Not Reported

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

10
WNW
1/2-1 mi
4127

DOF000000037103
FAA DOF

Unique ID: 230834
City: DETROIT
Verification Status: verified
Latitude: 42 20 26N
Frequency: Not Reported
Above Ground Level Height (Ft.):
Above Mean Sea Level Height (Ft.):
Horizontal Accuracy: +-100'
Painted/Marked: Not Reported

Obstruction #: 0834
State: Michigan
Obstruction Type: BLDG
Longitude: 083 01 58W
Type of Lighting: Not Reported
0217
00823
Vertical Accuracy: +-20'
FAA Study #: Stereoplot

11
West
1/2-1 mi
4185

DOF000000037101
FAA DOF

Unique ID: 230832
City: DETROIT
Verification Status: verified
Latitude: 42 20 10N
Frequency: Not Reported
Above Ground Level Height (Ft.):
Above Mean Sea Level Height (Ft.):
Horizontal Accuracy: +-100'
Painted/Marked: No

Obstruction #: 0832
State: Michigan
Obstruction Type: BLDG
Longitude: 083 02 05W
Type of Lighting: No Lights
0312
00910
Vertical Accuracy: +-20'
FAA Study #: Stereoplot

12
WNW
1/2-1 mi
4488

DOF000000037207
FAA DOF

Unique ID: 230953
City: DETROIT
Verification Status: verified
Latitude: 42 20 25N
Frequency: Not Reported
Above Ground Level Height (Ft.):
Above Mean Sea Level Height (Ft.):
Horizontal Accuracy: +-100'
Painted/Marked: No

Obstruction #: 0953
State: Michigan
Obstruction Type: BLDG 2
Longitude: 083 02 04W
Type of Lighting: Not Reported
0210
00813
Vertical Accuracy: +-20'
FAA Study #: Stereoplot

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

13
NW
1/2-1 mi
4613

DOF000000037106
FAA DOF

Unique ID: 230837
City: DETROIT
Verification Status: verified
Latitude: 42 20 43N
Frequency: Not Reported
Above Ground Level Height (Ft.):
Above Mean Sea Level Height (Ft.):
Horizontal Accuracy: +-500'
Painted/Marked: Not Reported

Obstruction #: 0837
State: Michigan
Obstruction Type: BLDG
Longitude: 083 01 47W
Type of Lighting: Not Reported
0202
00822
Vertical Accuracy: +-50'
FAA Study #: Letter Reported

14
West
1/2-1 mi
4853

TOW100000061237
TOWER

Tower ID: 47524
Tower Owner Name:
1326 ST ANTOINE, DETROIT, MI
Latitude: 42 20' 152409"
Longitude: 83 2' 14"
Transmitter Latitude: 422009
Construction Date: 99/99/1999
FAA Date:
File Number: 2556-PS-ML-89
Antenna Height: 0.0000
Beacon Height: 0.0000
Elevation: 807.0000
Elevation FAA (M): 0.0000
Structure Height: 207.0000
Structure Height FAA: 0.0000
Supporting Struct Hgt: 0.0000
Tower Height: 0.0000
Structure Type: TOW
Key Remarks:
Key Site: 60843
ID Exam:
Paint and Lighting Specs: 2 21
Special Conditions/Remarks:

Latitude (in seconds): 152409
Longitude (in seconds): 298934
Transmitter Longitude: 0830214
Activation Date:
FCC Date: Aug 16 1968
FAA ID:
Antenna Height (M): 0.0000
Beacon Height (M): 0.0000
Elevation FAA: 0.0000
Elevation (M): 246.0000
Structure Height (M): 63.1000
Structure Height FAA (M): 63.1000
Supporting Struct Hgt (M): 0.0000
Tower Height (M): 0.0000
Tower Type: E
Date:
Record Action: OLD
ID_ASB_ACC: Y

This record is for a license, and it may or may not indicate a site which has been built.

FCC & FAA SITES MAP FINDINGS

Map ID
Direction
Distance
Distance (ft.)

EDR ID
Database

15
NE
1/2-1 mi
4854

DOF000000036736
FAA DOF

Unique ID:	230446	Obstruction #:	0446
City:	DETROIT	State:	Michigan
Verification Status:	verified	Obstruction Type:	STACKS
Latitude:	42 20 36N	Longitude:	083 00 18W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):			0285
Above Mean Sea Level Height (Ft.):			00870
Horizontal Accuracy:	Not Reported	Vertical Accuracy:	Not Reported
Painted/Marked:	Yes	FAA Study #:	Not Reported

16
WNW
1/2-1 mi
5218

DOF000000037102
FAA DOF

Unique ID:	230833	Obstruction #:	0833
City:	DETROIT	State:	Michigan
Verification Status:	verified	Obstruction Type:	BLDG
Latitude:	42 20 26N	Longitude:	083 02 14W
Frequency:	Not Reported	Type of Lighting:	Not Reported
Above Ground Level Height (Ft.):			0241
Above Mean Sea Level Height (Ft.):			00845
Horizontal Accuracy:	+/-100'	Vertical Accuracy:	+/-20'
Painted/Marked:	Not Reported	FAA Study #:	Stereoplot

KEY CONTACTS & GOVERNMENT RECORDS SEARCHED

Various Federal laws and executive orders address specific environmental concerns. NEPA requires the responsible offices to integrate to the greatest practical extent the applicable procedures required by these laws and executive orders. EDR provides key contacts at agencies charged with implementing these laws and executive orders to supplement the information contained in this report.

NATURAL AREAS

Officially designated wilderness areas

Government Records Searched in This Report

FED_LAND: Federal Lands

Source: USGS

Telephone: 703-648-5094

Federal data from Bureau of Land Management, National Park Service and Forest Service and Fish and Wildlife Service.

- National Parks
- Forests
- Monuments
- Wildlife Sanctuaries, Preserves, Refuges
- Federal Wilderness Areas.

Date of Government Version: 09/01/1997

Federal Contacts for Additional Information

USDA Forest Service, Eastern

310 West Wisconsin Avenue

Milwaukee, WI 53203

414-297-3693

BLM - Eastern States Office

7450 Boston Blvd.

Springfield, VA 22153

703-440-1713

Fish & Wildlife Service, Region 3

BHW Federal Building One Federal Drive

Fort Snelling, MN 55111-4056

612-713-5230

Officially designated wildlife preserves, sanctuaries and refuges

Government Records Searched in This Report

FED_LAND: Federal Lands

Source: USGS

Telephone: 703-648-5094

Federal data from Bureau of Land Management, National Park Service and Forest Service and Fish and Wildlife Service.

- National Parks
- Forests
- Monuments
- Wildlife Sanctuaries, Preserves, Refuges
- Federal Wilderness Areas.

Date of Government Version: 09/01/1997

KEY CONTACTS & GOVERNMENT RECORDS SEARCHED

Government Records Searched in This Report

MI_FACILITY

Facilities Database

Dept. of Natural Resources facilities for the state of Michigan. Facilities include: linear state parks, state parks, state game areas, wildlife research areas, state forest, and state fish hatcheries.

Source: Department of Natural Resources

Telephone: 517-373-2534

Federal Contacts for Additional Information

Fish & Wildlife Service, Region 3

BHW Federal Building One Federal Drive

Fort Snelling, MN 55111-4056

612-713-5230

State Contacts for Additional Information

Dept. of Natural Resources 517-373-1280

Wild and scenic rivers

Government Records Searched in This Report

FED_LAND: Federal Lands

Source: USGS

Telephone: 703-648-5094

Federal data from Bureau of Land Management, National Park Service and Forest Service and Fish and Wildlife Service.

- National Parks

- Forests

- Monuments

- Wildlife Sanctuaries, Preserves, Refuges

- Federal Wilderness Areas.

Date of Government Version: 09/01/1997

Federal Contacts for Additional Information

Fish & Wildlife Service, Region 3

BHW Federal Building One Federal Drive

Fort Snelling, MN 55111-4056

612-713-5230

Endangered Species

Federal Contacts for Additional Information

Fish & Wildlife Service, Region 3

BHW Federal Building One Federal Drive

Fort Snelling, MN 55111-4056

612-713-5230

State Contacts for Additional Information

Natural Features Inventory 517-373-1552

KEY CONTACTS & GOVERNMENT RECORDS SEARCHED

LANDMARKS, HISTORICAL, AND ARCHEOLOGICAL SITES

Historic Places

Government Records Searched in This Report

National Register of Historic Places:

The National Register of Historic Places is the official federal list of districts, sites, buildings, structures, and objects significant in American history, architecture, archeology, engineering, and culture. These contribute to an understanding of the historical and cultural foundations of the nation.

The National Register includes:

- All prehistoric and historic units of the National Park System;
- National Historic Landmarks, which are properties recognized by the Secretary of the Interior as possessing national significance; and
- Properties significant in American, state, or local prehistory and history that have been nominated by State Historic Preservation Officers, federal agencies, and others, and have been approved for listing by the National Park Service.

Date of Government Version: 03/15/2000

FED_LAND: Federal Lands

Source: USGS

Telephone: 703-648-5094

Federal data from Bureau of Land Management, National Park Service and Forest Service and Fish and Wildlife Service.

- National Parks
- Forests
- Monuments
- Wildlife Sanctuaries, Preserves, Refuges
- Federal Wilderness Areas.

Date of Government Version: 09/01/1997

Federal Contacts for Additional Information

Park Service; Advisory Council on Historic Preservation

1849 C Street NW

Washington, DC 20240

Phone: (202) 208-6843

State Contacts for Additional Information

State Historic Preservation Office 517-373-1630

Indian Religious Sites

Federal Contacts for Additional Information

Department of the Interior- Bureau of Indian Affairs

Office of Public Affairs

1849 C Street, NW

Washington, DC 20240-0001

Office: 202-208-3711

Fax: 202-501-1516

National Association of Tribal Historic Preservation Officers

1411 K Street NW, Suite 700

Washington, DC 20005

Phone: 202-628-8476

Fax: 202-628-2241

KEY CONTACTS & GOVERNMENT RECORDS SEARCHED

State Contacts for Additional Information

Minneapolis Area Office, Bureau of Indian Affairs
331 S. Second Avenue
Minneapolis, MN 55401
612-373-1000

Scenic Trails

State Contacts for Additional Information

North County Trail Association
49 Monroe Center Suite 200B
Grand Rapids, Michigan 49503
616-454-5506

FLOOD PLAIN, WETLANDS AND COASTAL ZONE

Flood Plain Management

Government Records Searched in This Report

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

Federal Contacts for Additional Information

Federal Emergency Management Agency 877-3362-627

State Contacts for Additional Information

Dept. of State Police, Emergency Management Div. 517-333-5041

Wetlands Protection

Government Records Searched in This Report

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 1999 from the U.S. Fish and Wildlife Service.

Federal Contacts for Additional Information

Fish & Wildlife Service 813-570-5412

State Contacts for Additional Information

Dept. of Natural Resources 517-373-1280

Coastal Zone Management

Government Records Searched in This Report

CAMA Management Areas
Dept. of Env., Health & Natural Resources
919-733-2293

Federal Contacts for Additional Information

Office of Ocean and Coastal Resource Management
N/ORM, SSMC4
1305 East-West Highway
Silver Spring, Maryland 20910
301-713-3102

State Contacts for Additional Information

Land & Water Management Division 517-373-1950

KEY CONTACTS & GOVERNMENT RECORDS SEARCHED

FCC & FAA SITES MAP

For NEPA actions that come under the authority of the FCC, the FCC requires evaluation of Antenna towers and/or supporting structures that are to be equipped with high intensity white lights which are to be located in residential neighborhoods, as defined by the applicable zoning law.

Government Records Searched in This Report

Cellular

Federal Communications Commission
Mass Media Bureau
2nd Floor - 445 12th Street SW
Washington DC 20554 USA
Telephone (202) 418-2700

Portions copyright (C) 1999 Percon Corporation. All rights reserved.

Tower

Federal Communications Commission
Mass Media Bureau
2nd Floor - 445 12th Street SW
Washington DC 20554 USA
Telephone (202) 418-2700

Portions copyright (C) 1999 Percon Corporation. All rights reserved.

Antenna Registration

Federal Communications Commission
Mass Media Bureau
2nd Floor - 445 12th Street SW
Washington DC 20554 USA
Telephone (202) 418-2700

Portions copyright (C) 1999 Percon Corporation. All rights reserved.

AM Tower

Federal Communications Commission
Mass Media Bureau
2nd Floor - 445 12th Street SW
Washington DC 20554 USA
Telephone (202) 418-2700

FAA Digital Obstacle File

National Oceanic and Atmospheric Administration
Telephone: 301-436-8301

Describes known obstacles of interest to aviation users in the US. Used by the Federal Aviation Administration (FAA) and the National Oceanic and Atmospheric Administration to manage the National Airspace System.

KEY CONTACTS & GOVERNMENT RECORDS SEARCHED

OTHER CONTACT SOURCES

NEPA Single Point of Contact

State Contacts for Additional Information
Southeast Michigan Council of Governments
660 Plaza Drive
Suite 1900
Detroit, MI 48226
313-961-4266

Excessive Radio Frequency Emission

For NEPA actions that come under the authority of the FCC, Commission actions granting construction permits, licenses to transmit or renewals thereof, equipment authorizations or modifications in existing facilities, require the determination of whether the particular facility, operation or transmitter would cause human exposure to levels of radio frequency in excess of certain limits.

Federal Contacts for Additional Information

Office of Engineering and Technology
Federal Communications Commission
445 12th Street SW
Washington, DC 20554
Phone: 202-418-2470



The EDR-City Directory
Abstract

USCG Detroit Atwater Property
2660 E. Atwater St
Detroit, MI 48207

May 04, 2001

Inquiry Number: 625908-9

The Source
For Environmental
Risk Management
Data

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802

Environmental Data Resources, Inc.

City Directory Abstract

Environmental Data Resources, Inc.'s (EDR) City Directory Abstract is a screening tool designed to assist professionals in evaluating potential liability on a target property resulting from past activities. ASTM E 1528-00, Section 7.3 on Historical Use Information, identifies the prior use requirements for a Phase I environmental site assessment. The ASTM standard requires a review of *reasonably ascertainable standard historical sources*. *Reasonably ascertainable means information that is publicly available, obtainable from a source with reasonable time and cost constraints, and practically reviewable.*

To meet the prior use requirements of ASTM E 1528-00, Section 7.3.4, the following *standard historical sources* may be used: aerial photographs, fire insurance maps, property tax files, land title records (although these cannot be the sole historical source consulted), topographic maps, city directories, building department records, or zoning/land use records. ASTM E 1528-00 requires *All obvious uses of the property shall be identified from the present, back to the property's obvious first developed use, or back to 1940, whichever is earlier. This task requires reviewing only as many of the standard historical sources as are necessary, and that are reasonably ascertainable and likely to be useful.* (ASTM E 1528-00, Section 7.3.4, page 12. EDR's City Directory Abstract includes a search and abstract of available city directory data.

City Directories

City directories have been published for cities and towns across the U.S. since the 1700s. Originally a list of residents, the city directory developed into a sophisticated tool for locating individuals and businesses in a particular urban or suburban area. Twentieth century directories are generally divided into three sections: a business index, a list of resident names and addresses, and a street index. With each address, the directory lists the name of the resident or, if a business is operated from this address, the name and type of business (if unclear from the name). While city directory coverage is comprehensive for major cities, it may be spotty for rural areas and small towns. ASTM E 1528-00 specifies that a *review of city directories (standard historical sources) at less than approximately five year intervals is not required by this practice.* (ASTM E 1528-00, Section 7.3.4, page 12.)

Please call EDR Nationwide Customer Service at
1-800-352-0050 (8am-8pm EST)
with questions or comments about your report.
Thank you for your business!

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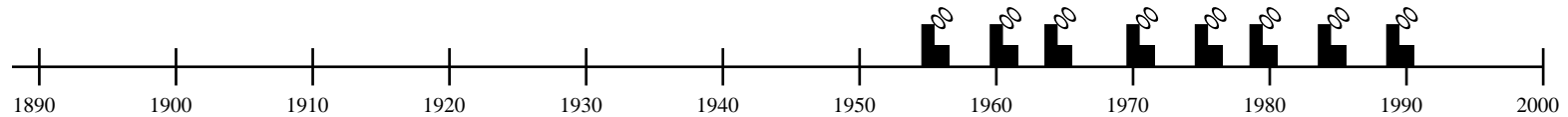
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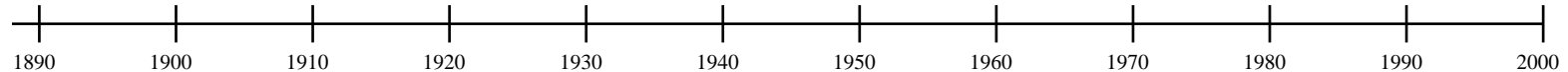
Prior Use Report® Timeline

Target Property

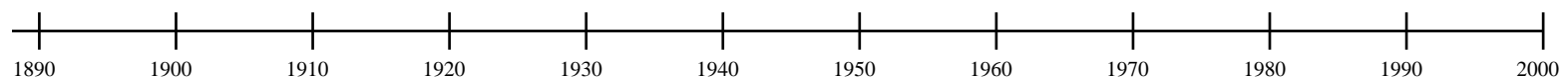


Adjoining Property Not Available

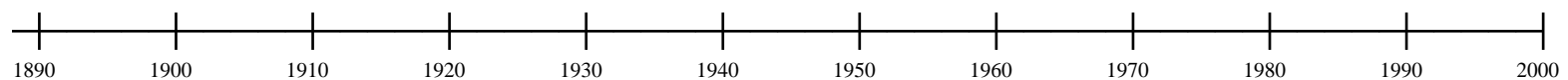
Front



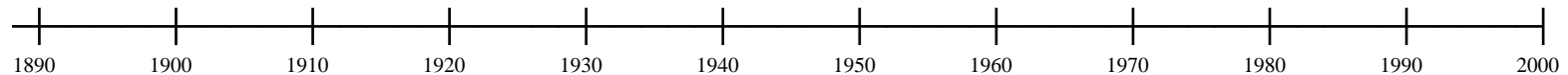
Back



Left




Right



Legend:

 = Historical Topographic Map (HT)

 = National Wetland Inventory Map (WT) *

Superscript number corresponds to graph ID in text


**Displayed on timeline when aerial photos, flood prone, FEMA, wetland maps, or Aerial Research Summary are purchased.*

 = Flood Prone/FEMA Maps (FP/FR) *

 = Aerial Photos Included (P) *

 = Aerial Photos Available *

 = Residential (R)

 = Commercial or Industrial (C)

Target Property: USCG Detroit Atwater Property
Address: 2660 E. Atwater St
City/State/Zip: Detroit, MI 48207

Customer: Tetra Tech NUS, Inc.
Contact: Robert Davis
Inquiry #: 625908-9
Date: 05/04/2001

4. SUMMARY

- ***City Directories:***

Business directories including city, cross reference and telephone directories were reviewed, if available, at approximately five year intervals for the years spanning 1956 through 2000. (These years are not necessarily inclusive.) A summary of the information obtained is provided in the text of this report.

Date EDR Searched Historical Sources:

City Directories

May 02, 2001

Target Property:

2660 E. Atwater St

Detroit, MI 48207

<u>PUR ID</u>		<u>Portion-Findings</u> <u>(FIM Information Only)</u>	<u>Source</u>
<u>Year</u>	<u>Uses</u>		
-- 1956	Treasury Dept-Coast Guard Division		Polk's City Directory
-- 1961	Treasury Dept-Coast Guard Division		Polk's City Directory
-- 1965	Treasury Dept-Coast Guard Division		Polk's City Directory
-- 1971	US Coast Guard Reserve, US Org Reserve Training		Bressers Criss-Cross Directory
-- 1976	US Coast Guard Reserve, US Org Reserve Training		Bressers Criss-Cross Directory
-- 1980	US Coast Guard, US Officer Safety		Bressers Criss-Cross Directory
-- 1985	US Coast Guard, US Officer Safety		Bressers Criss-Cross Directory
-- 1990	US Coast Guard Reserve, USCG Inspection, US Officer Safety		Bressers Criss-Cross Directory
-- 1995	Address not Listed in Research Source		Bressers Criss-Cross Directory
-- 2000	Address not Listed in Research Source		Bressers Criss-Cross Directory

Adjoining Properties**SURROUNDING**

2660 East Atwater Street

Detroit, MI 48207

Surrounding Area Property Log of Address Changes

2000

2660 East Atwater Street

<u>PUR ID</u>		<u>Portion-Findings</u> <u>(FIM Information Only)</u>	<u>Source</u>
<u>Year</u>	<u>Uses</u>		
1956	**Atwater Street Addresses** Northern Engineering (2615) Penn-Dixie Industries Inc (2652) Detroit River Iron Works (2655) -No Listings in 2700 Blk		Polk's City Directory
1961	**Atwater Street Addresses** Northern Engineering (2615) Penn-Dixie Industries Inc (2652) Detroit River Iron Works (2655) -No Listings in 2700 Blk		Polk's City Directory

<i>PUR ID</i>	<i>Uses</i>	<i>Portion-Findings</i> <i>(FIM Information Only)</i>	<i>Source</i>
1965	<p>**Atwater Street Addresses**</p> <p>Northern Engineering (2615)</p> <p>Penn-Dixie Industries Inc (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings in 2700 Blk</p>		Polk's City Directory
1971	<p>**Atwater Street Addresses**</p> <p>Address Not Listed in Research Source (2615)</p> <p>Penn-Dixie Industries Inc (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings in 2700 Blk</p>		Bressers Criss-Cross Directory
1976	<p>**Atwater Street Addresses**</p> <p>Address Not Listed in Research Source (2615)</p> <p>Penn-Dixie Industries Inc (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings in 2700 Blk</p>		Bressers Criss-Cross Directory
1980	<p>**Atwater Street Addresses**</p> <p>Address Not Listed in Research Source (2615)</p> <p>Dundee Cement Co (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings in 2700 Blk</p>		Bressers Criss-Cross Directory
1985	<p>**Atwater Street Addresses**</p> <p>Address Not Listed in Research Source (2615)</p> <p>Dundee Cement Co (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings in 2700 Blk</p>		Bressers Criss-Cross Directory
1990	<p>**Atwater Street Addresses**</p> <p>Address Not Listed in Research Source (2615)</p> <p>Dundee Cement Co (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings Beyond TP</p>		Bressers Criss-Cross Directory
1995	<p>**Atwater Street Addresses**</p> <p>Address Not Listed in Research Source (2615)</p> <p>Dundee Cement Co (2652)</p> <p>Detroit River Iron Works (2655)</p> <p>-No Listings Beyond 2600 Blk</p>		Bressers Criss-Cross Directory

<i><u>PUR ID</u></i> <i><u>Year</u></i>	<i><u>Uses</u></i>	<i><u>Portion-Findings</u></i> <i><u>(FIM Information Only)</u></i>	<i><u>Source</u></i>
2000	**Atwater Street Addresses** Incite Design Works (2615) Holnam Inc (2652) Detroit River Inn (2655) -No Listings Beyond 2600 Blk		Bressers Criss-Cross Directory

Glossary of Terms

A.A.A.

Aerial photograph flyer: Agriculture Adjustment Administration (Federal).

A.S.C.S

Aerial photograph flyer: Agricultural Stabilization and Conservation Service (Federal)

Address Change

Indicates that a change of address has occurred; indicates new address. A change of address may occur when a city, street, or the address ranges of a street are restructured.

Address in Research Source

Indicates that a property is listed at a different address than the one provided by the user. Generally occurs when a property is located on a corner or, when the physical address of a property is different than its mailing address.

Address Not Listed in Research Source

Occurs when a specific site address is not listed in city directories and/or fire insurance maps.

Adjoining

Any property that is contiguous, or a property that would be contiguous if not for a public thoroughfare, to the target property. *To differentiate from each adjoining property, stand at the target property's "front door" facing the street.*

Adjoining Back

Property directly to the rear of the target property.

Adjoining Front

Property directly in front of the target property.

Adjoining Left

Property directly to the left of the target property.

Adjoining Right

Property directly to the right of the target property.

Adjoining Surrounding Area

Property that may adjoin the target property but due to lack of specific map information cannot be located precisely. This situation typically occurs when city directory information, but not fire insurance map information, is available.

C.A.S

Aerial photograph flyer: Chicago Aerial Survey (private).

C.S.S.

Aerial photograph flyer: Commodity Stabilization Service (Federal).

Cartwright

Aerial photograph flyer: Cartwright (private)

CD

City Directory

Commercial

Any property including, but not limited to, property used for industrial, retail, office, agricultural, other commercial, medical, or educational purposes; property used for residential purposes that has more than four residential dwelling units.

Commercial or Industrial

Property that has either a commercial *or* an industrial use. Examples include retail stores, manufacturing facilities, factories, and apartment buildings.

D.N.R.

Aerial photograph flyer: Department of National Resources (state).

D.O.T.

Aerial photograph flyer: Department of Transportation (state).

Fairchild

Aerial photograph flyer: Fairchild (private).

FIM

Fire Insurance Map

Flood Insurance Rate Maps

Flood Insurance Rate Maps are produced by the Federal Emergency Management Agency (FEMA). These maps indicate special flood hazard areas, base flood elevations and flood insurance risk zones.

Flood Prone Area Maps

Flood Prone Area maps are produced by the United States Geological Survey (USGS). Areas identified as flood prone have been determined by available information gathered from past floods.

F.S.

Aerial photograph flyer: Forest Service (Federal).

Geonex

Aerial photograph flyer: Geonex (private).

M.C.

Aerial photograph flyer: Metropolitan Council of the Twin Cities Area (state).

Map Required Not Available in Local Collection

Property is located on a fire insurance map sheet not available in local and/or microfilm collection.

Mark Hurd

Aerial photograph flyer: Mark Hurd (private)

Multiple Locations

Indicates that there are two or more sites adjoining the target property's border.

N.A.P.P.

Aerial photograph flyer: National Aerial Photography Program (Federal).

National Wetland Inventory Maps

National Wetland Inventory Maps are produced by the U.S. Fish and Wildlife Service, a division of the U.S. Department of the Interior. Wetland and deepwater habitat information is identified on a 7.5 minute U.S.G.S. topographic map. The classification system used categorizes these habitats into five systems: marine, estuarine, riverine, lacustrine and palustrine.

No Return

Indicates that site owner was unavailable at time of surveyor's contact. *Applies only to city directories.*

No Structure Identified on Parcel

Used when site boundaries and/or site address is indicated on a fire insurance map; no structure details exist.

Other

Occurs when the site's classification is different than EDR's standard categories. Examples may include undeveloped land and buildings with no specified function.

P.M.A.

Aerial photograph flyer: Production and Marketing Administration (Federal).

Pacific Aerial

Aerial photograph flyer: Pacific Aerial (private)

Portion

Refers to the fire insurance map information identified on the four quadrants of a target or adjoining property. The portions are referred to as *Frontright*, *Frontleft*, *Backright*, and *Backleft* and are determined as if one were standing at the front door, facing the street.

Property Not Defined

Used when property is not clearly demarcated on a fire insurance map.

Residential

Any property having fewer than five dwelling units used exclusively for residential purposes.

Residential with Commercial Uses (a.k.a. Multiple Purpose Address)

A business (firm) and residence at the same address. Examples include a doctor, attorney, etc. working out of his/her home.

Sidwell

Aerial photograph flyer: Sidwell (private).

Site Not Mapped

Occurs when an adjoining property has not been mapped by fire insurance map surveyors.

Teledyne

Aerial photograph flyer: Teledyne (private)

Topographic Maps

Topographic maps are produced by the United States Geological Survey (USGS). These maps are color coded line and symbol representations of natural and selected artificial features plotted to scale.

Turnbow

Aerial photograph flyer: Michael Turnbow (private)

U.S.D.A.

Aerial photograph flyer: United States Department of Agriculture (Federal).

U.S.D.I.

Aerial photograph flyer: United States Department of the Interior (Federal).

U.S.G.S.

Aerial photograph flyer: United States Geological Survey (Federal).

Vacant

May refer to an unoccupied structure or land. *Used only when fire insurance map or city directory specifies 'vacant.'*

W.P.A.

Aerial photograph flyer: Works Progress Administration (Federal).

WALLACE

Aerial photograph flyer: Wallace (private).

APPENDIX D

PREVIOUS REPORTS

ASBESTOS AND LEAD SAMPLE RESULTS BROKEN WATER-LINE VALVE

U.S. Department
of Transportation

United States
Coast Guard



Commander
Maintenance & Logistics Command
Atlantic

300 E. Main St., Ste. 1000
Norfolk, Va. 23510-9109
Staff Symbol: kse
Phone: (757) 628-4392

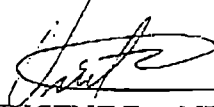
6260

MAY 2 1997

From: Commander, Maintenance and Logistics Command Atlantic
To: Commander, U.S. Coast Guard Group Detroit

SUBJ: ASBESTOS AND LEAD SAMPLE RESULTS

1. On 03 April 1997 LTJG Kathy Slawson and HSC Charles Reich conducted an asbestos and lead paint survey as part of our Customer, Assistance & Training visit. Enclosure (1) contains the summary results and enclosure (2) contains the lab results. The asbestos sample tested negative. All samples for lead tested positive.
2. Keep these results on file to notify contractors or any personnel involved in future site work that lead is present. Enclosure (3) gives guidance on safe removal of lead containing paint.
3. For additional information your point of contact is LT Richard Orlando at (757) 628-4392.
4. CUSTOMER SATISFACTION.....OUR MOST IMPORTANT SERVICE.


VINCENT F. ANDREONE

By direction

Encl: (1) Summary Report
(2) Lab results
(3) MLCA Guidance

Copy: CG CEU Cleveland

OPTIONAL FORM 99 (7-90)

FAX TRANSMITTAL

of pages ► 9

To <i>Mr. Ray Emond</i>	From <i>LTJG Kathy Slawson</i>
Dept./Agency <i>GP Detroit Gen. Foreman</i>	Phone # <i>(757) 628-4406</i>
Fax # <i>(313) 568-9532</i>	Fax # <i>(757) 628-4418</i>

NSN 7540-01-317-7388 5099-101 GENERAL SERVICES ADMINISTRATION

LEAD SAMPLING RESULTS

USCG GROUP DETROIT

ATWATER BUILDING

04/03/97

SAMPLE NO.	DESCRIPTION	LOCATION	% LEAD (W/W)
L1	Yellow paint chips	Stairway wall to 2 nd deck	0.255
L2	White paint chips	Stairway wall to 2 nd deck	0.107
L3	Blue/grey paint chips	Stairway wall to 2 nd deck	0.948
L4	Red paint chips	1 st deck woodbrick floor	4.2
L5	White paint chips	Boiler room near main entrance	0.12
L6	Grey paint chips	Boiler room near main entrance	1.5
L7	Orange/yellow paint chips	Door pillar inside main entrance	18.3
L8	Grey paint chips	Inside main entrance door frame	19.4

Conclusions: All samples contain lead.

Recommendations: Lead is present and care should be taken in removal by mechanical means such as grinders or heat. These methods may liberate lead dusts or fumes in concentrations above the Coast Guard Exposure Standard.

ENCL (/)

LEAD SAMPLING RESULTS**USCG GROUP DETROIT****ATWATER GARAGE****04/03/97**

SAMPLE NO.	DESCRIPTION	LOCATION	% LEAD (W/W)
L1	Blue/black paint chips	Outside door panel on overhead door	5.67
L2	Green paint chips	Overhead door frame	4.43

Conclusions: All samples contain lead.

Recommendations: Lead is present and care should be taken in removal by mechanical means such as grinders or heat. These methods may liberate lead dusts or fumes in concentrations above the Coast Guard Exposure Standard.

BULK ASBESTOS SAMPLING RESULTS**USCG GROUP DETROIT****ATWATER BUILDING****04/03/97**

SAMPLE NO.	DESCRIPTION	LOCATION	ASBESTOS TYPE
A1	Tan mastic ceiling tile	2 nd deck MK room	0 Not detected

Conclusions: All samples containing 1% asbestos or greater are considered to be asbestos containing materials. This sample is asbestos-free.

August 18, 1997

Mr. Ray Emond
United States Coast Guard Base Detroit
110 Mt. Elliot Avenue
Detroit, Michigan 48207-4380

Subject: USCG Base Detroit's Atwater Facility, Detroit, Michigan.

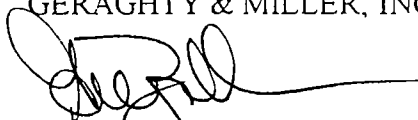
Dear Mr. Emond:

As you requested, enclosed is a copy of the letter Geraghty & Miller, Inc. submitted to the Michigan Department of Environmental Quality (MDEQ) related to the pipeline break at the United States Coast Guard (USCG) Base Detroit's Atwater Facility located in Detroit, Michigan.

If you have any questions, please contact the undersigned at (248) 305-9400.

Respectfully submitted,

GERAGHTY & MILLER, INC.



Gregory Zellmer, P.G.
Project Geologist

c: Denise Hancsak, United States Coast Guard
Eric P. Carman, Geraghty & Miller, Inc.



July 10, 1997

Mr. Ray Spaulding
Michigan Department of Environmental Quality
Environmental Response Division
38980 Seven Mile Road
Livonia, Michigan 48152

FILE COPY

Subject: USCG Base Detroit's Atwater Facility, Detroit, Michigan.

Dear Mr. Spaulding:

This letter summarizes Geraghty & Miller, Inc. assessment of site conditions at the United States Coast Guard (USCG) Base Detroit's Atwater Facility located in Detroit, Michigan (see Figure 1). In March 1997, USCG personnel discovered a broken water-line valve located in the warehouse building on the site (see Figure 2). According to USCG personnel, the water-line valve froze and broke, sending water throughout the shop area of the warehouse, beneath a roll-up garage door located on the southern side of the warehouse, and into a boat slip located on the Detroit River. When USCG personnel discovered the leak, they noted a hydrocarbon odor in the shop; however, no sheen was observed on the water in the shop nor on the water in the slip. The USCG reported the incident to the Michigan Department of Environmental Quality (MDEQ) Environmental Response Division (ERD) on March 27, 1997.

In April 1997, the USCG requested that Geraghty & Miller evaluate the incident and prepare a site assessment work plan to determine if the soil or groundwater may have become impacted as a result of the broken valve. Geraghty & Miller conducted a site visit on April 16, 1997, to evaluate site conditions. Based on Geraghty & Miller's observations, we believe that a site assessment is not necessary. Geraghty & Miller's observations of the site conditions and conclusions are summarized below.

The site is paved with asphalt and has a two-story brick warehouse located on the northwestern portion of the site and a boat slip located south of the warehouse (see Figure 2). The boat slip is on the Detroit River. According to USCG personnel, the building was built in the late 1930s to early 1940s and was previously owned by the U.S. Army. The U.S. Army used the warehouse as a maintenance shop for small boats and for storage. The USCG uses the building for storage. The USCG does not use nor store chemicals, petroleum hydrocarbon products, or hazardous compounds on-site.

During the site visit, no water was observed in the building; however, a faint hydrocarbon odor was noticed. The hydrocarbon odor appeared to emanate from the wooden block flooring within the shop area of the warehouse. The flooring of the shop consists of 2-inch by 4-inch by 2-



Mr. Spaulding

July 10, 1997

Page 2

inch wooden blocks that overlay an approximately 4-inch thick cement slab. Some of the wooden block flooring had swollen and lifted off the floor as a result of the flooding. Geraghty & Miller inspected some of the wooden blocks and noted that the bottom of the wooden blocks appeared to have been stained or treated with oil. According to USCG personnel, a petroleum-based adhesive may have been used to attach the wooden blocks to the cement slab. The cement slab beneath the wooden blocks appeared to be in good condition, and no cracks were observed. No stains were observed on the floor of the shop, and no other environmental concerns related to the broken valve were observed during the site visit.

Based on the following observations, there appears to have been no adverse impacts to the environment as a result of the broken pipe line:

- No sheen was observed on the water in the shop or on the water in the boat slip.
- No cracks were observed in the cement slab beneath the wooden blocks.
- No stains were observed on the floor of the shop.
- No chemicals are stored by the USCG at the site.

Based on these observations, Geraghty & Miller requests, on behalf of the USCG, that the site be closed. Geraghty & Miller has recommended to the USCG that the wooden blocks be characterized prior to disposal.

If you have any questions, please contact the undersigned at (248) 305-9400.

Respectfully submitted,

GERAGHTY & MILLER, INC.



Gregory Zellmer, P.G.
Project Geologist



Steve Figgins
Associate/Regional Manager, Michigan

cc: Denise Hancsak, United States Coast Guard
Eric P. Carman, Geraghty & Miller, Inc.



DRAFTER:

APPROVED:

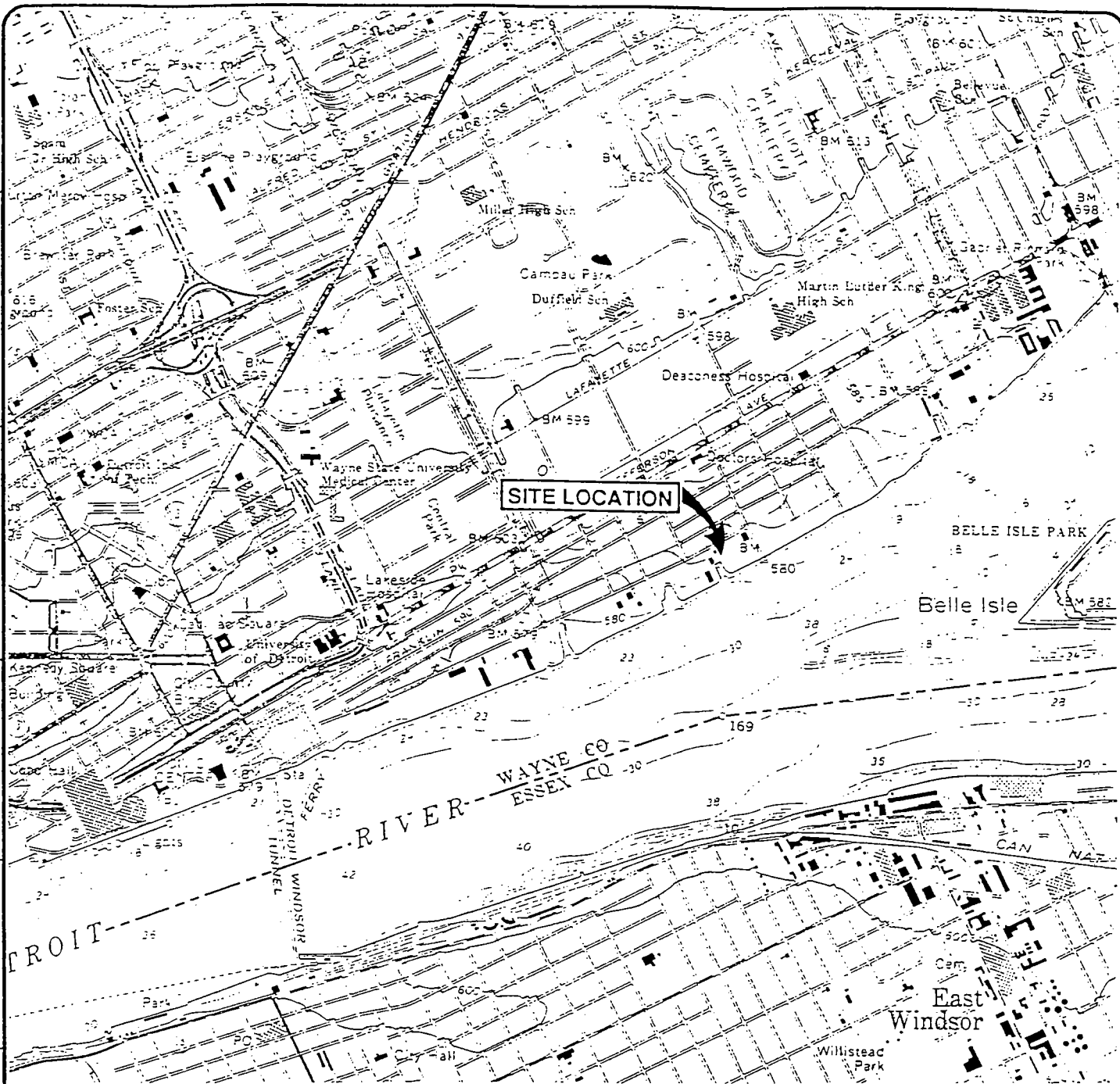
CHECKED:

DRAWING:

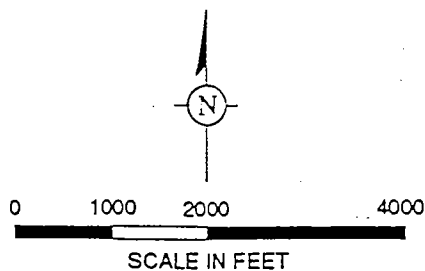
FILE NO.:

PRJCT NO.: M10591.001

DWG DATE: 15MAY97



SOURCE: USGS 7.5 Minute Topographic Maps, DETROIT, MICHIGAN-ONT. Quadrangle, 1968, photorevised 1973 and 1980.



SITE LOCATION MAP

UNITED STATES COAST GUARD BASE
DETROIT'S ATWATER FACILITY
DETROIT, MICHIGAN

FIGURE

1

DRAFTER: ELS

APPROVED:

CHECKED: GZ

DRAWING: USCG.AI

FILE NO.: M10591

PN: GRAPH_OH

DWG DATE: 16MAY97

ATWATER STREET

SIDEWALK

APPROXIMATE
LOCATION OF
BROKEN PIPE

GARAGE

SHOP

BOILER
ROOM

PAVED DRIVEWAY

FENCE

ROLLUP GARAGE
DOOR

BOAT SLIP
(DETROIT RIVER
APPROXIMATELY 150 FEET
TO THE SOUTH)



NOT TO SCALE



a heldemil company

SITE PLAN

UNITED STATES COAST GUARD BASE
DETROIT'S ATWATER FACILITY
DETROIT, MICHIGAN

FIGURE

2

* UNCLASSIFIED *

P 281700Z MAR 97 ZUI ASN-G02087000076

FM COMCOGARDGRU DETROIT MI

TO COGARD CEU CLEVELAND OH

BT

UNCLAS //N11330//

SUBJ: BASE DETROIT'S ATWATER FACILITY

A. PHONECON BETWEEN CWO4 THARRINGTON AND MS. DENISE

HANCSAK ON 27MAR97.

1. AT THE ATWATER FACILITY, A WATER PIPE RUPTURED DURING JANUARY 1997 AND SATURATED THE WOOD FLOOR. THIS RESULTED IN THE CENTER OF THE MAIN ROOM ON THE GROUND LEVEL DEVELOPING AN APPROXIMATE 4-5 FOOT DIAMETER UPWELLING IN THE FLOOR. THE UPWELLING IS APPROXIMATELY 6-8 INCHES IN HEIGHT. THE FLOOR IS CONSTRUCTED OF TREATED WOOD BRICKS AND POSSIBLY ADHERED WITH AN OIL PRODUCT SUCH AS TAR. BENEATH THIS FLOOR IS A CONCRETE FOUNDATION.

2. DUE TO THE FLOOR'S SATURATION, CONTAMINATED WATER LEACHED FROM THE WOOD AND ACCUMULATED ONTO THE FOUNDATION. THE AMOUNT OF PRODUCT APPEARS TO BE MINIMAL AND IS CONTAINED INSIDE THE ATWATER BUILDING.

3. NOTIFICATIONS WERE MADE TO THE NATIONAL RESPONSE CENTER AND MICHIGAN DEPARTMENT OF NATURAL RESOURCES.

4. REQUEST CEU CONTRACT ENVIRONMENTAL TESTING AND POSSIBLE SITE CLEANUP.

BT

NNNN

Posted By: AUTO 10:19:47 Mar 28, 97
Posted To: Mar-28-97
Viewed By: MKC 10:21:21 Mar 28, 97
EO 10:41:00 Mar 28, 97
YN1 12:08:23 Mar 28, 97
XO 17:06:20 Mar 28, 97
MST 09:21:06 Mar 29, 97

* UNCLASSIFIED *

APPENDIX E

USCG PHOTOGRAPHS AND DRAWINGS

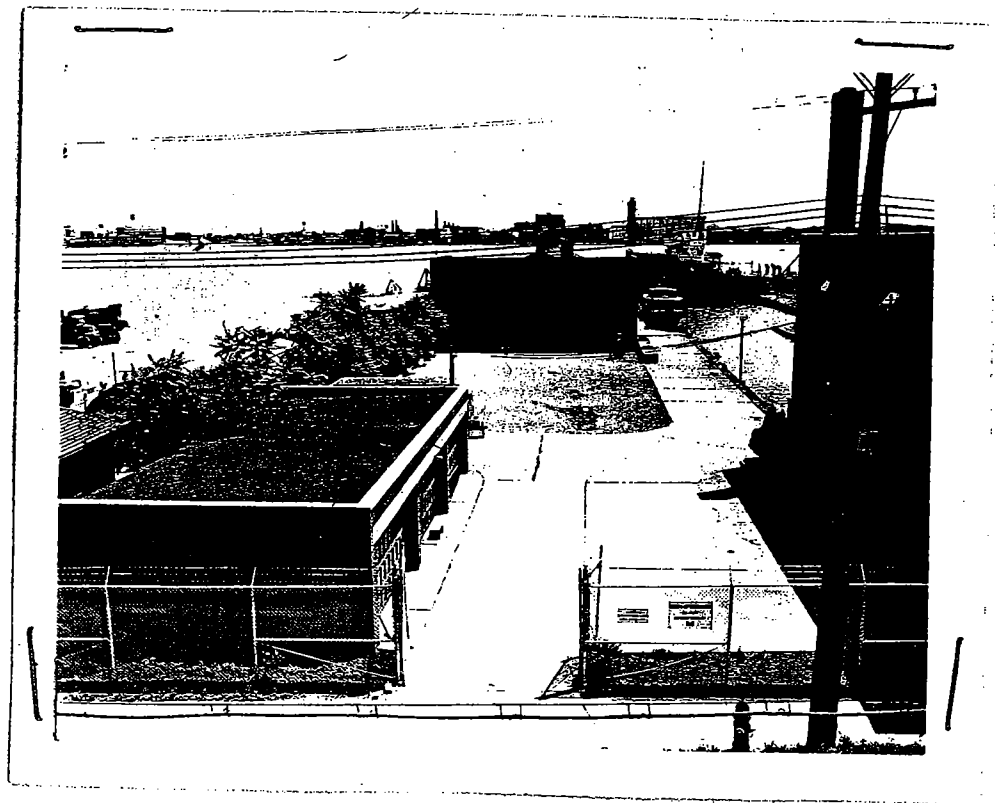


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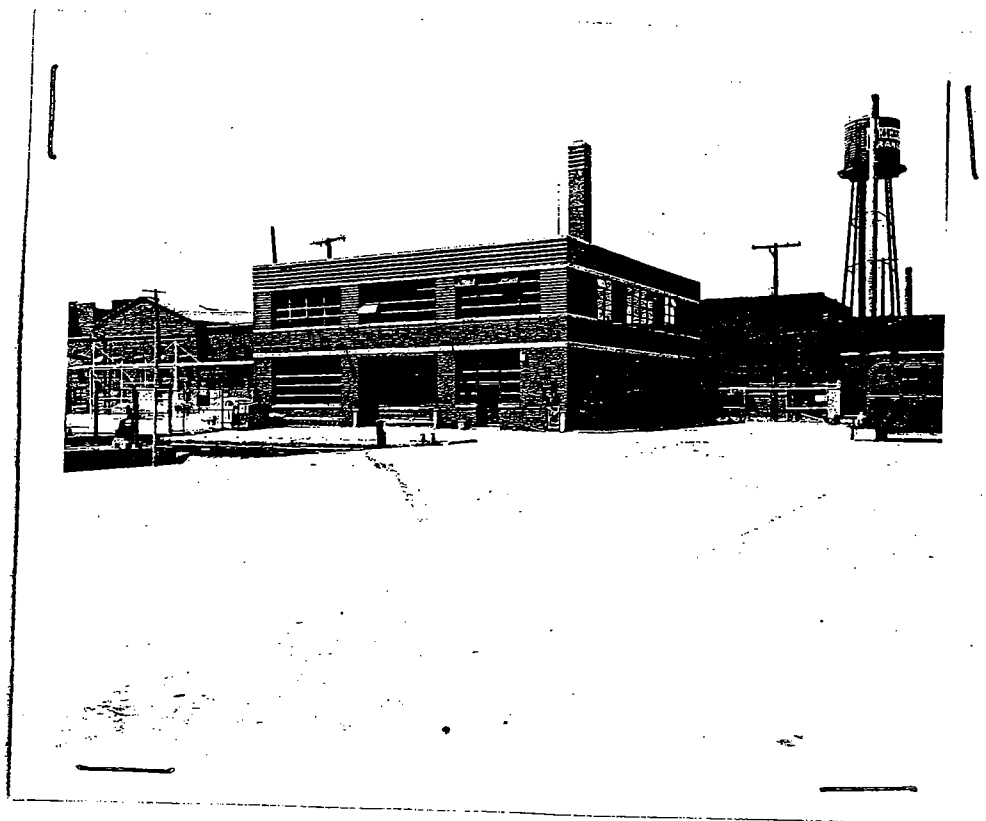


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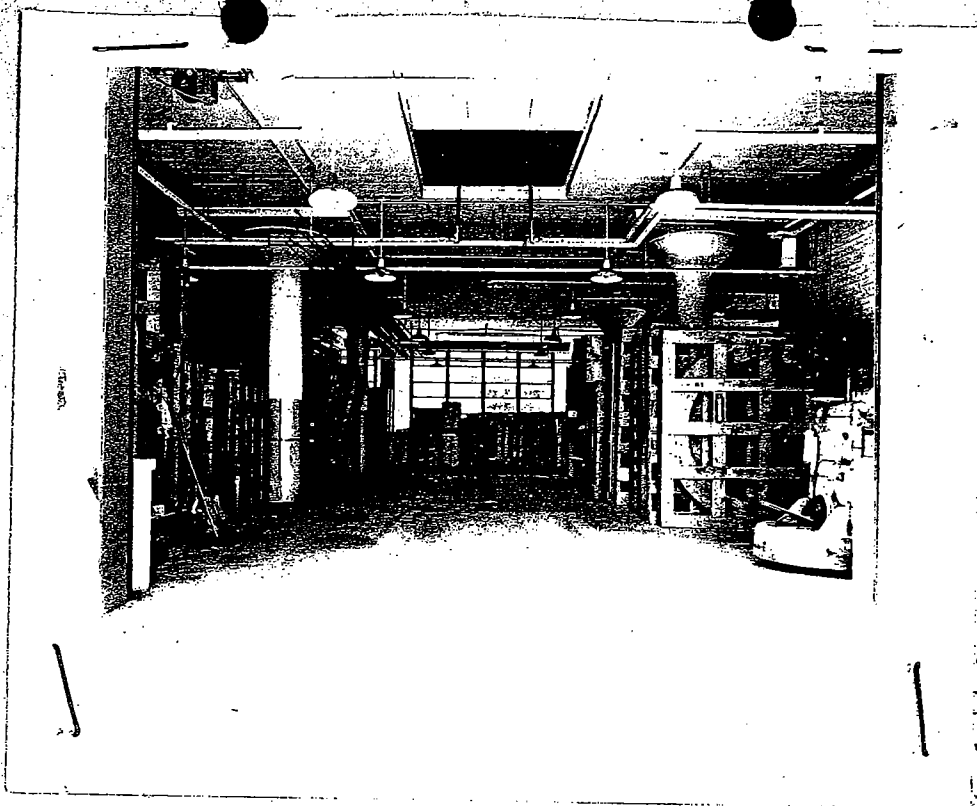


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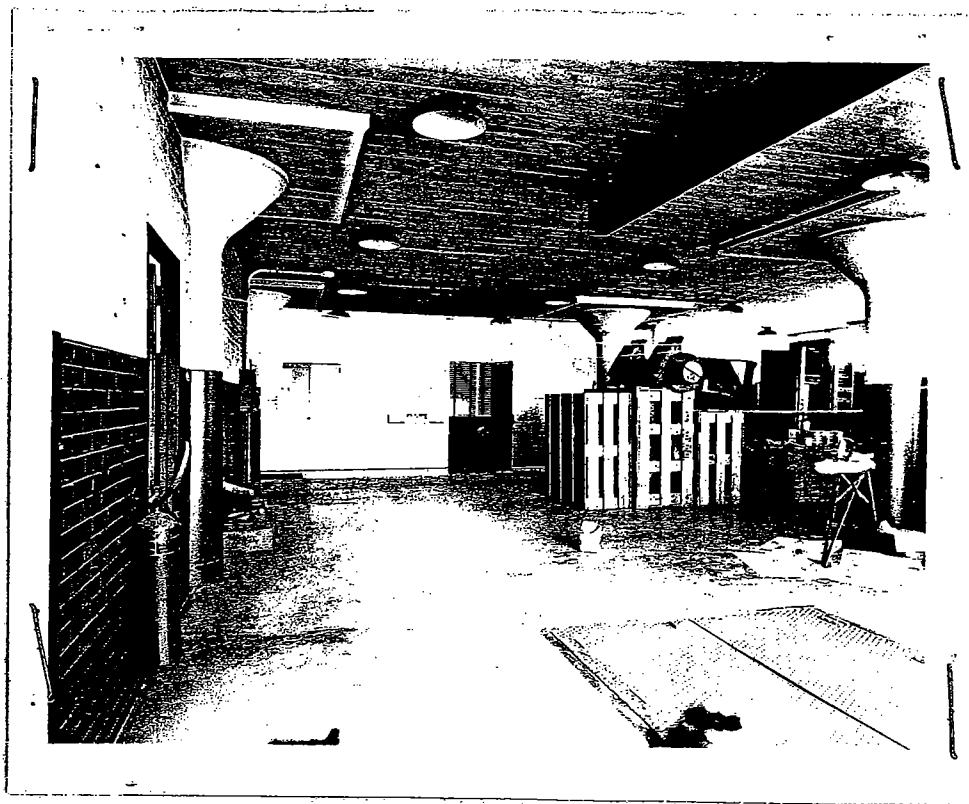


EXHIBIT 2B



EXHIBIT 2C

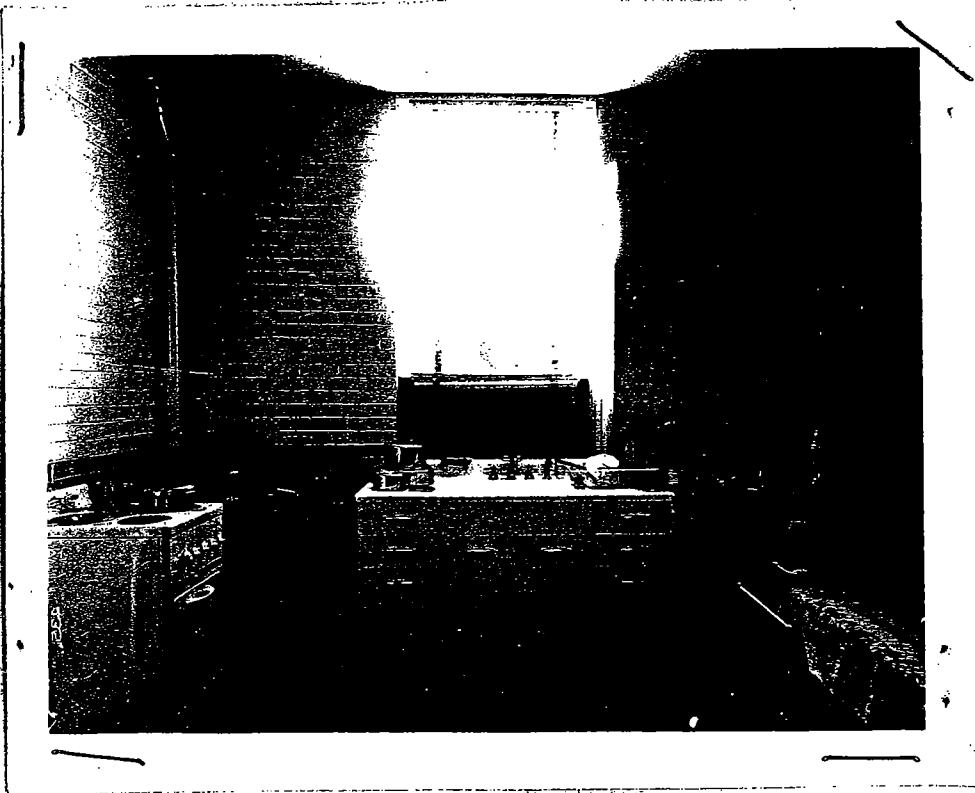


EXHIBIT 2D

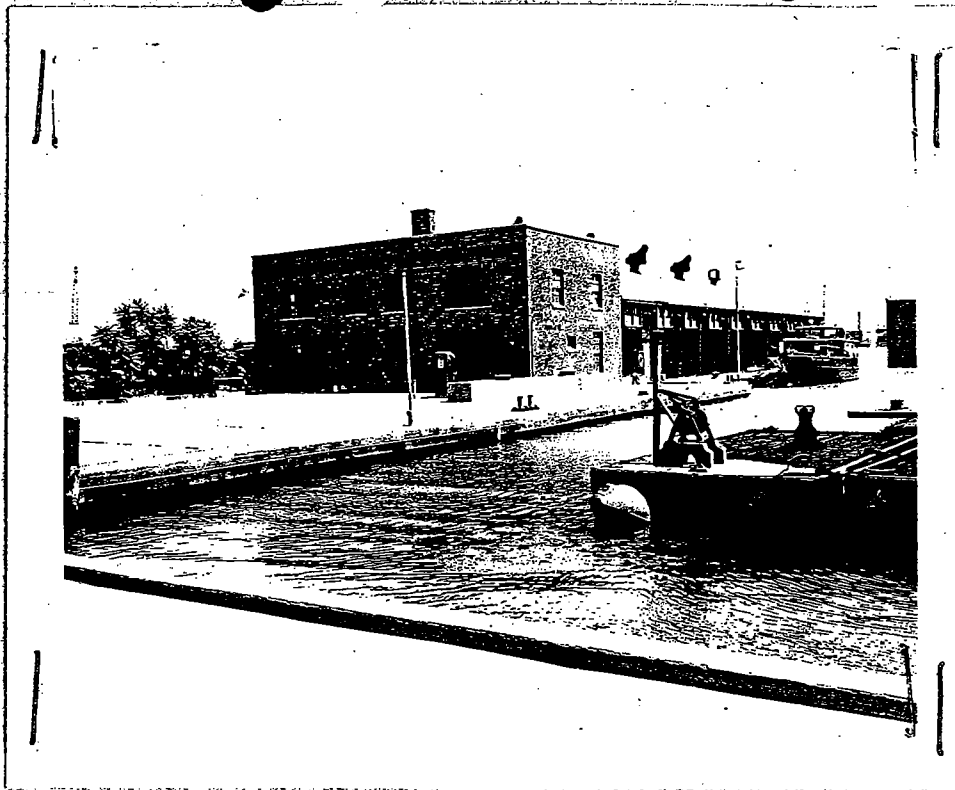


EXHIBIT 3



EXHIBIT 3A

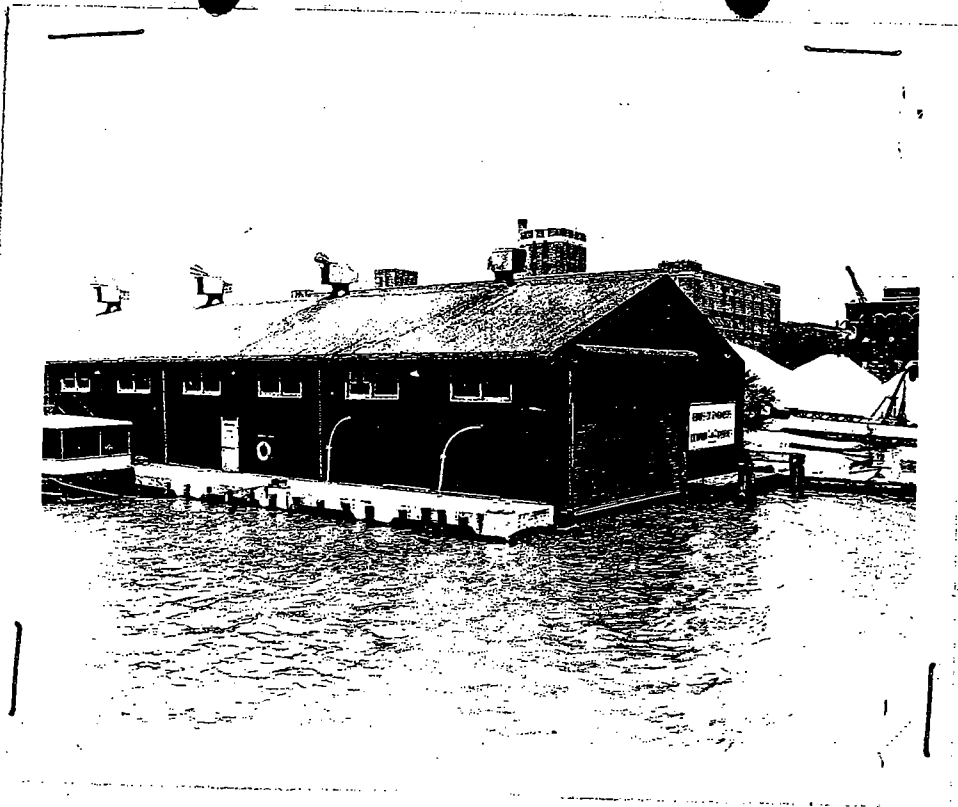


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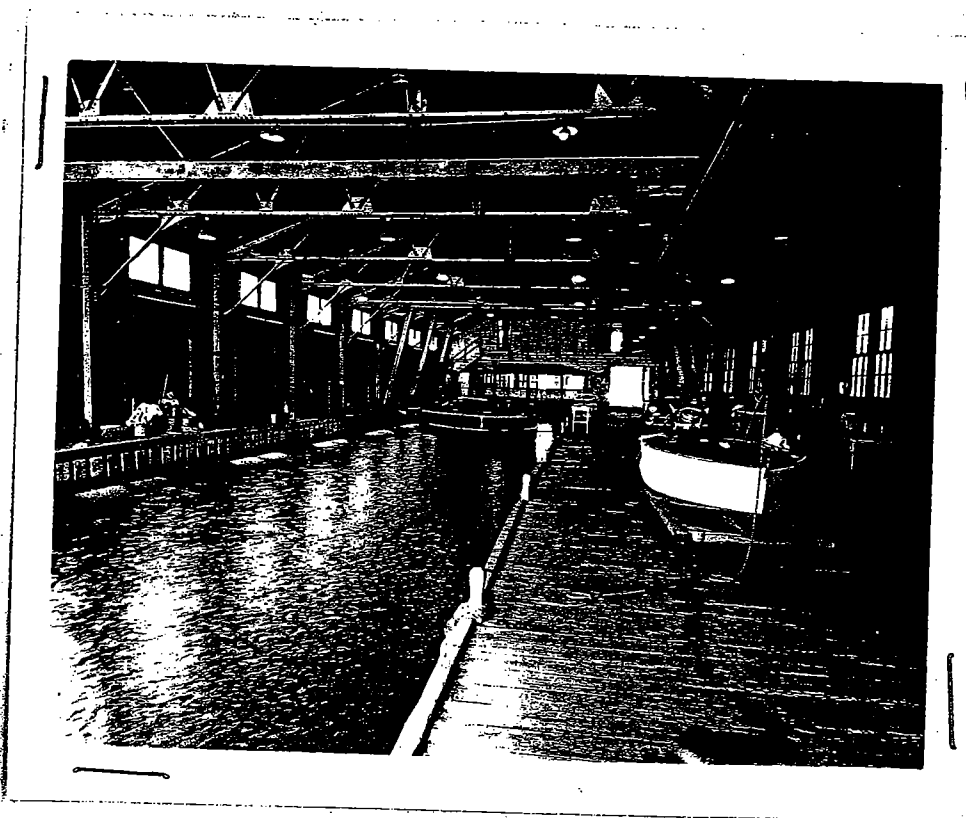


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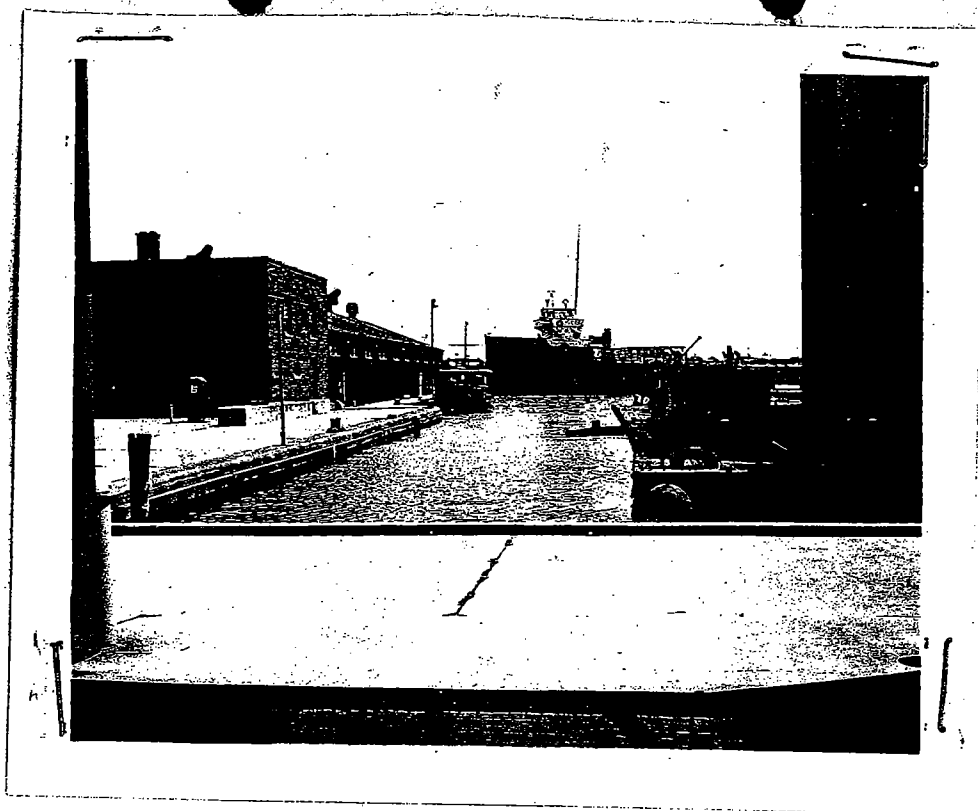


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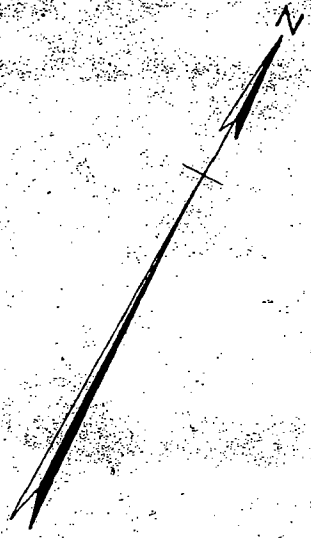
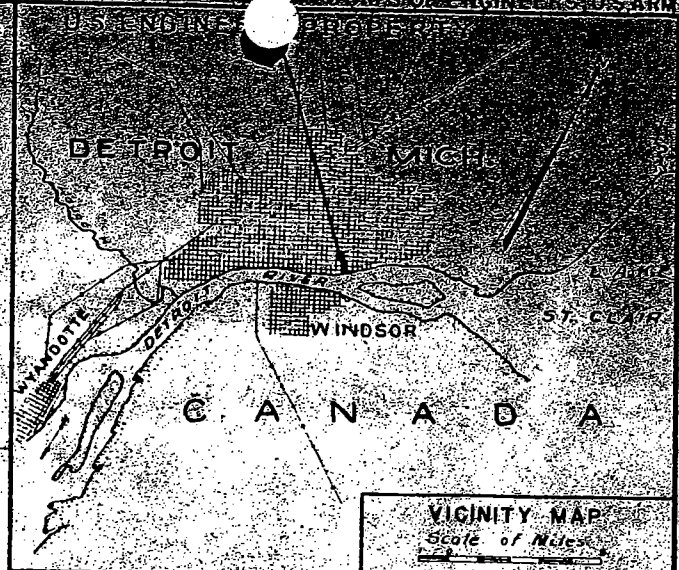
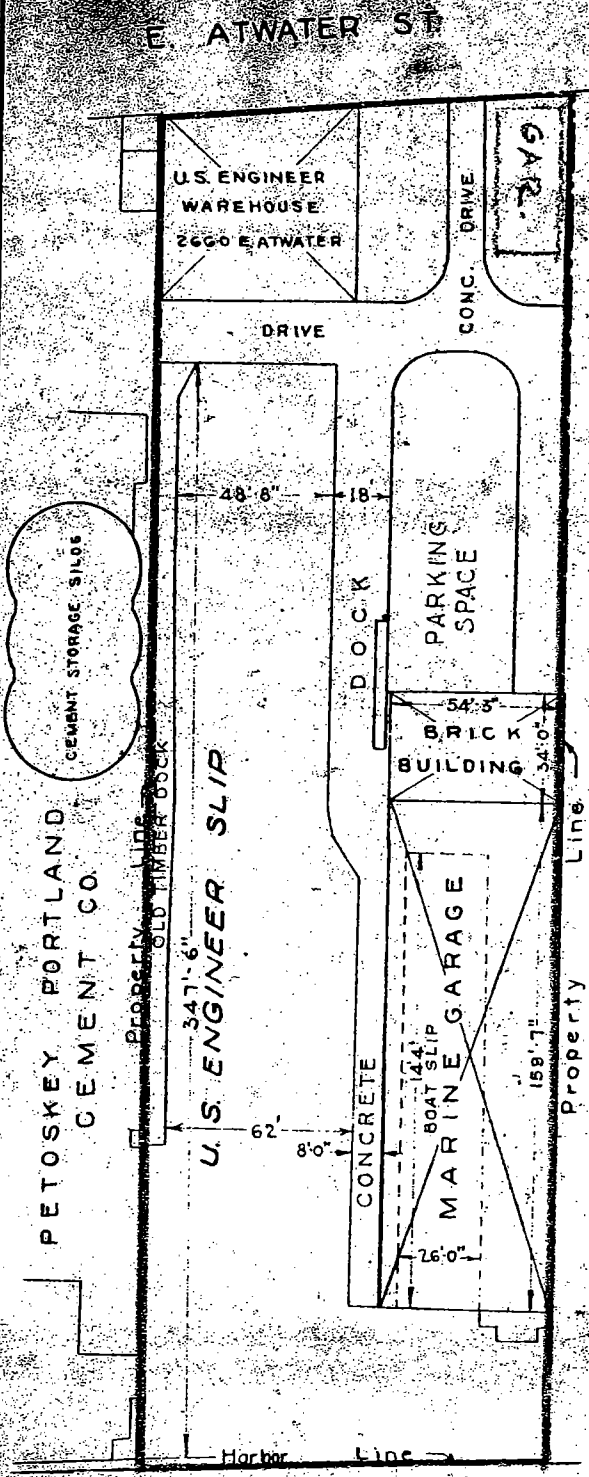


EXHIBIT A

**U.S. ENGINEER WAREHOUSE DOCK
2660 E. ATWATER ST., DETROIT, MICH.
LAYOUT PLAN**

In 1 Sheet

Scale 1:720

Scale of Feet
0 50 100

U. S. ENGINEER OFFICE, DETROIT, MICH., JAN. 28 1942

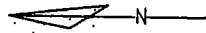
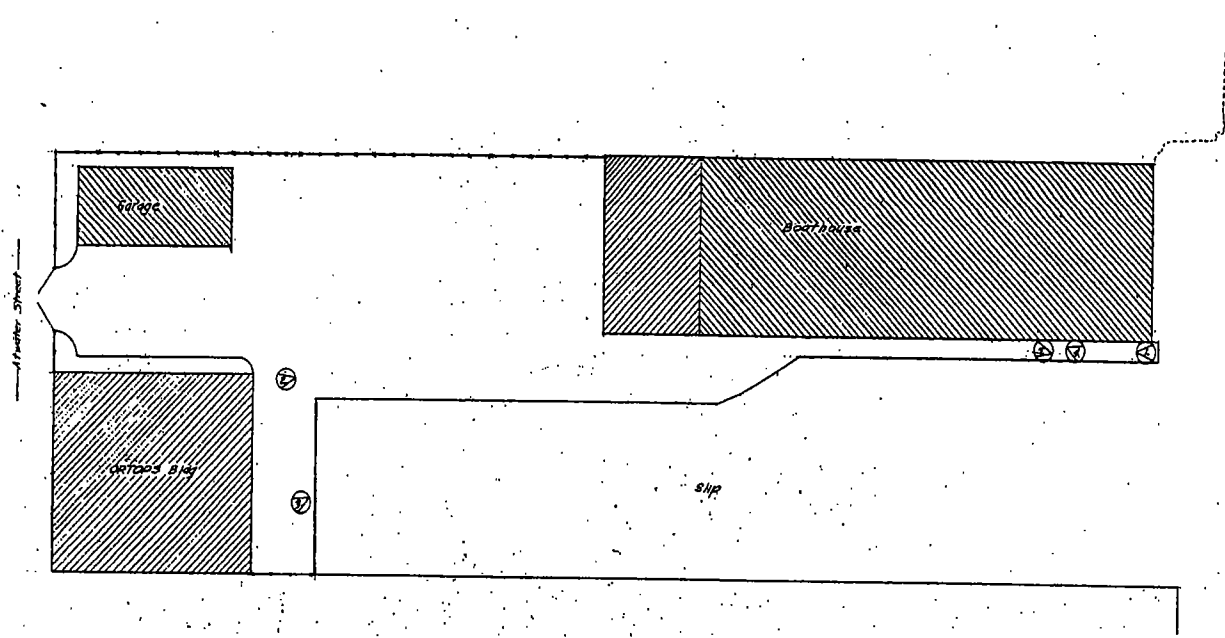
Submitted:

Approved:

John C. Trella
Sr. Engineer
Drawn by J.McC.

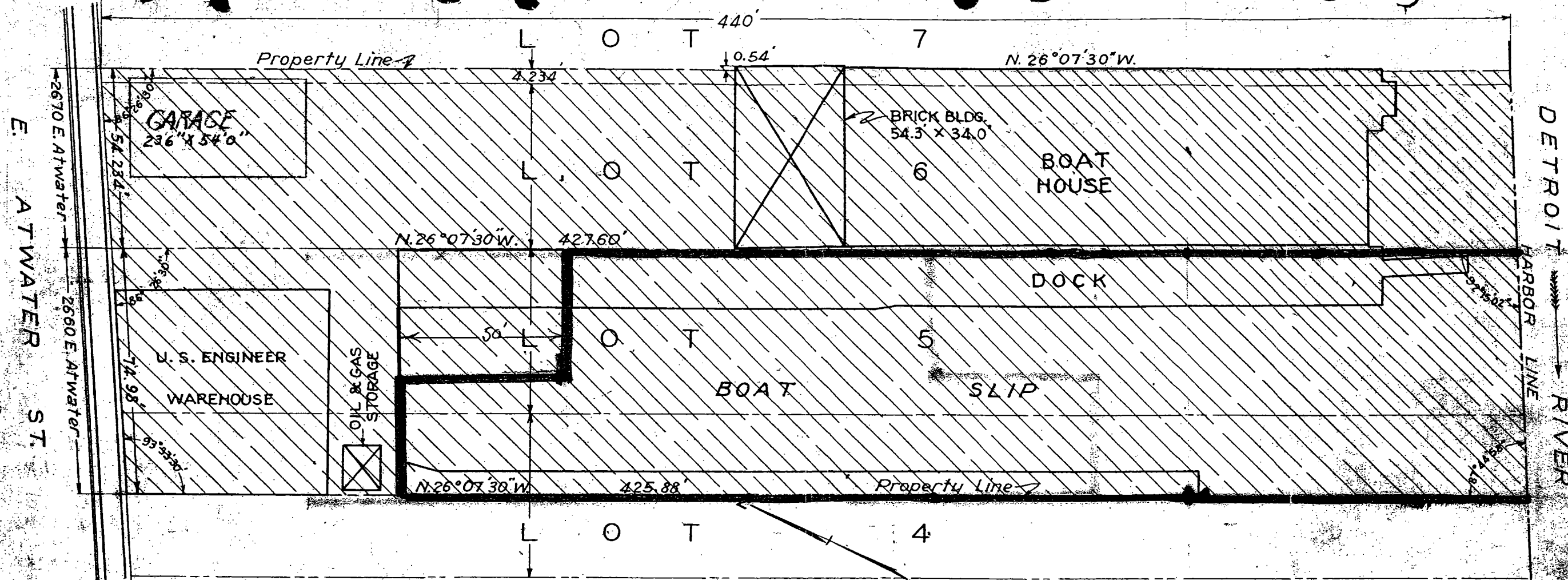
P. M. ...
Lt. Col., Corps of Engineers
File No. D.D.R. 18/191

DETROIT RIVER



③ - Reader: Portion Direction & Number
 For Corresponding Picture

REVISION	DATE	APPROVED	BY
U.S. COAST GUARD		NINTH DISTRICT CLEVELAND, OHIO	
CIVIL ENGINEERING			
DESIGNED -	PLOT PLAN		
DRAWN -	ATWATER ST. ORTOPS		
TRACED -	DETROIT MICH		
CHECKED -			
APPROVED	DATE		
CHIEF OF DIVISION	VEASE CHIEF OF DIVISION		
C.E. DRAWING NO.		1300-5	
SCALE		SHEET 1 OF 1	



*Description of Property at
2670 E. Atwater Street:*

*Lot 6 and westerly 4.234 feet of Lot N° 7 in Block "A"
subdivision of the Chene Farm, Wayne County,
City of Detroit, State of Michigan.*

Area of new property .526 Acres.

*Date of acquisition ~ Dec. 30, 1938 From John Pridgeon
Estate Company, by purchase, Cost \$25,000.*

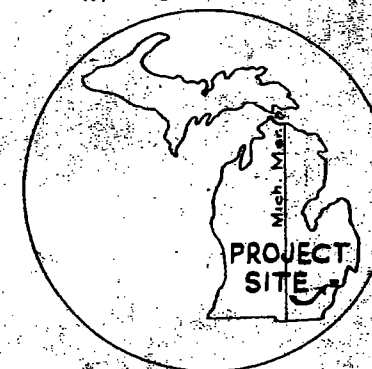
*Description of Property at
2660 E. Atwater Street:*

*Acquired by purchase from Mary L. McMillan et al
in 1904, All of Lot N° 5 & easterly half of Lot
N° 4, of Chene Farms = 0.73 acres.
New 2-story reinforced concrete warehouse,
erected in 1932. Cost of lot \$15,000*

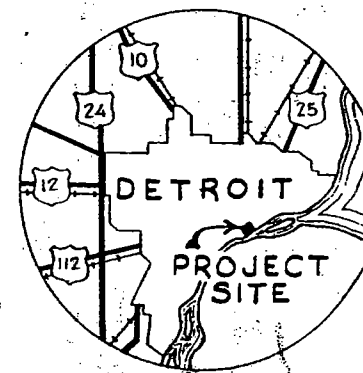
TOTAL ACRES ACQUIRED — 1.26

 1.26 ACRES TRANSFERRED TO U.S. COAST GUARD
ON 1 MARCH 1957

MICHIGAN



STATE INDEX



VICINITY MAP
STATUTE MILES

**CORPS OF ENGINEERS
ATWATER STREET WAREHOUSE**

In 1 Sheet Scale 1:400

Scale of Feet
10 0 10 20 30 40 50

U.S. ENGINEER OFFICE, DETROIT, MICH. AUG 6, 1938
Submitted: Approved:  

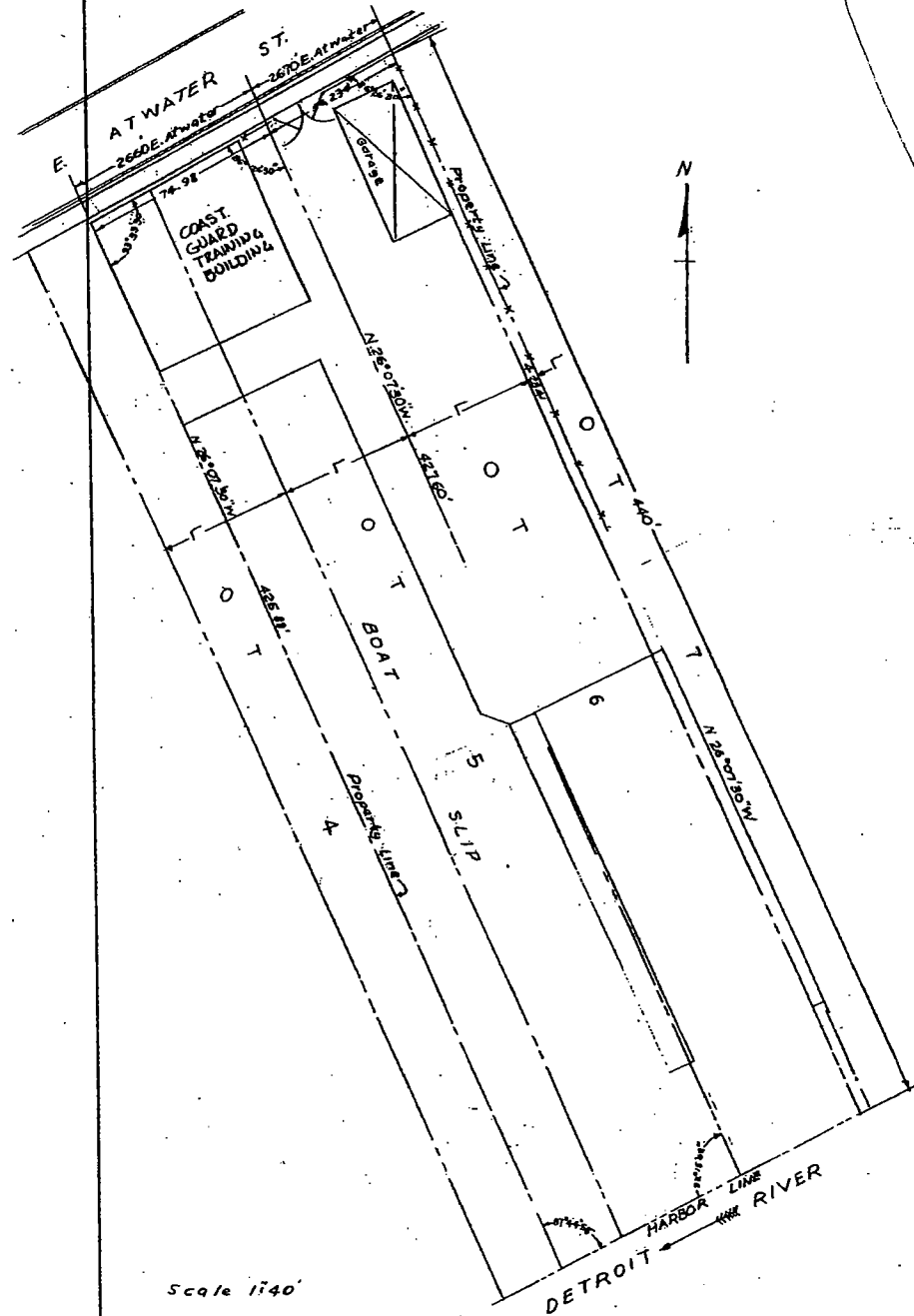
Senior Engineer Dept., Corps of Engineers

Drawn by L.N.L. PROJECT N° C230

Rvsd. 28 Mar. '60
Due to disposal:

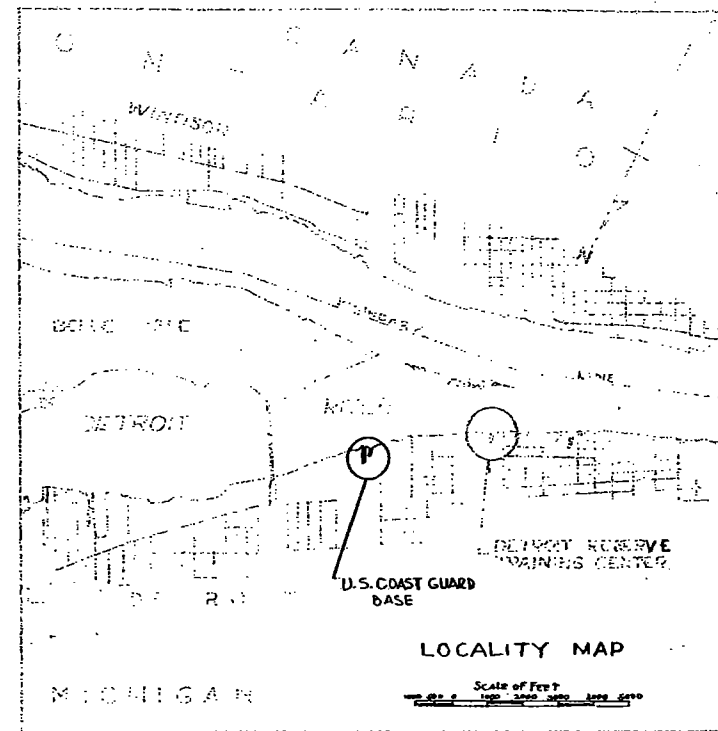
File N° 2-4/5-RE

EXHIBIT A



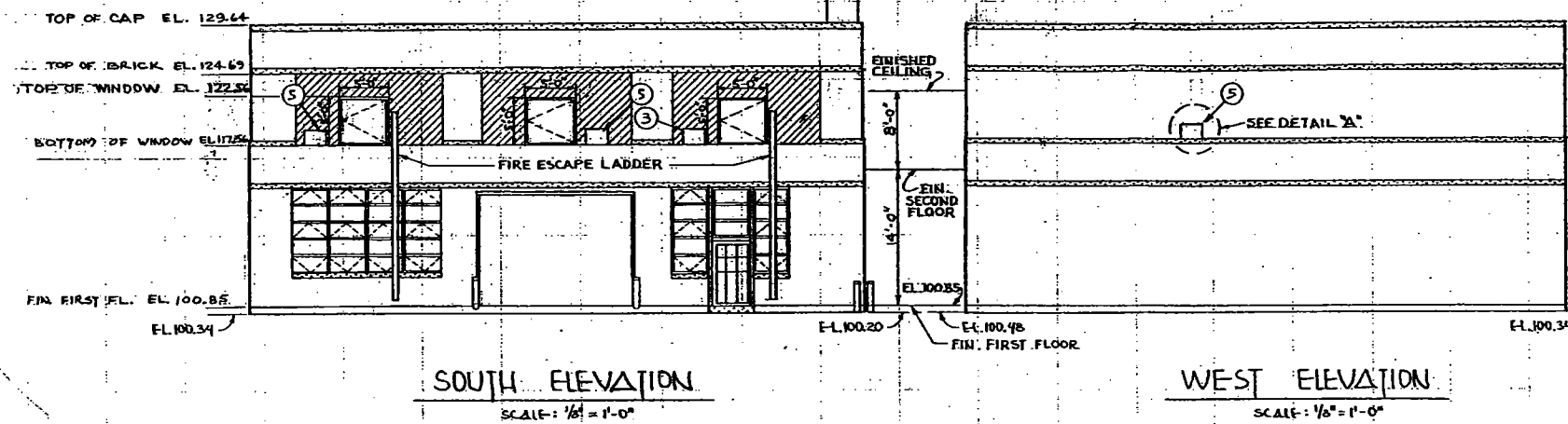
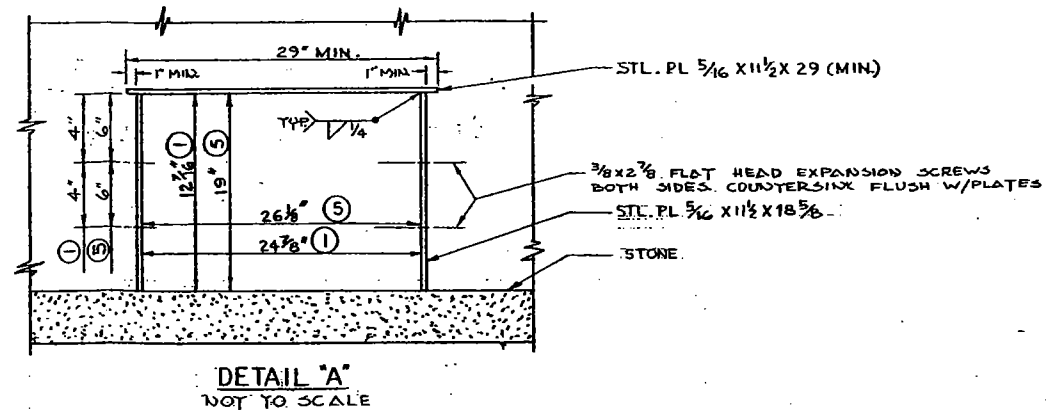
129.214'
125.88'
55029.7 sq ft = 1.26 acres

DETROIT RESERVE TRAINING UNIT
PLOT PLAN
SCALE OF FEET
0 400 800 1200 1600



CIVIL ENGINEERING	
DETROIT RESERVE TRAINING UNIT DETROIT MICHIGAN	
PLOT PLAN	
DATE: 11/19/62	
C.E. DRAWING NO. 1744-S	
SCALE: SHEET 1 OF 1	

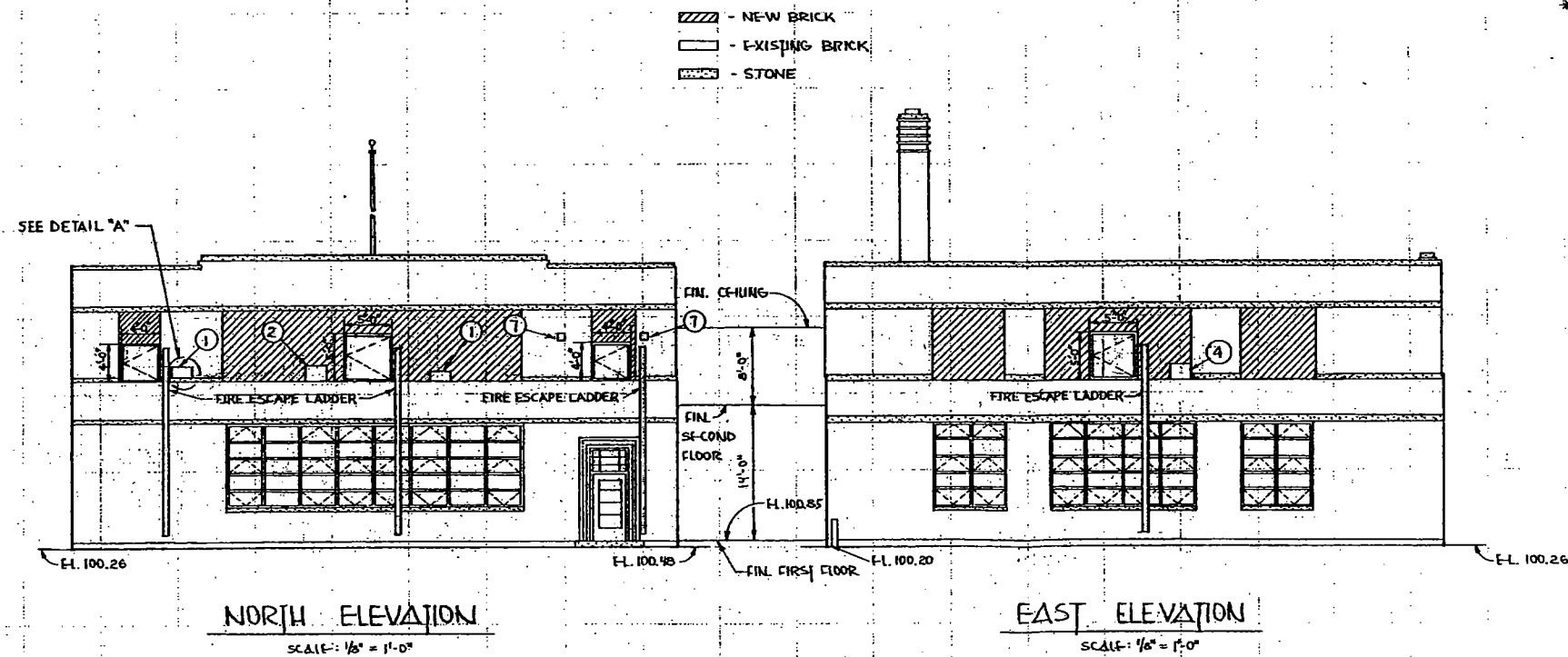
STATE FILE COPY, ANN ARBOR, MI
67118



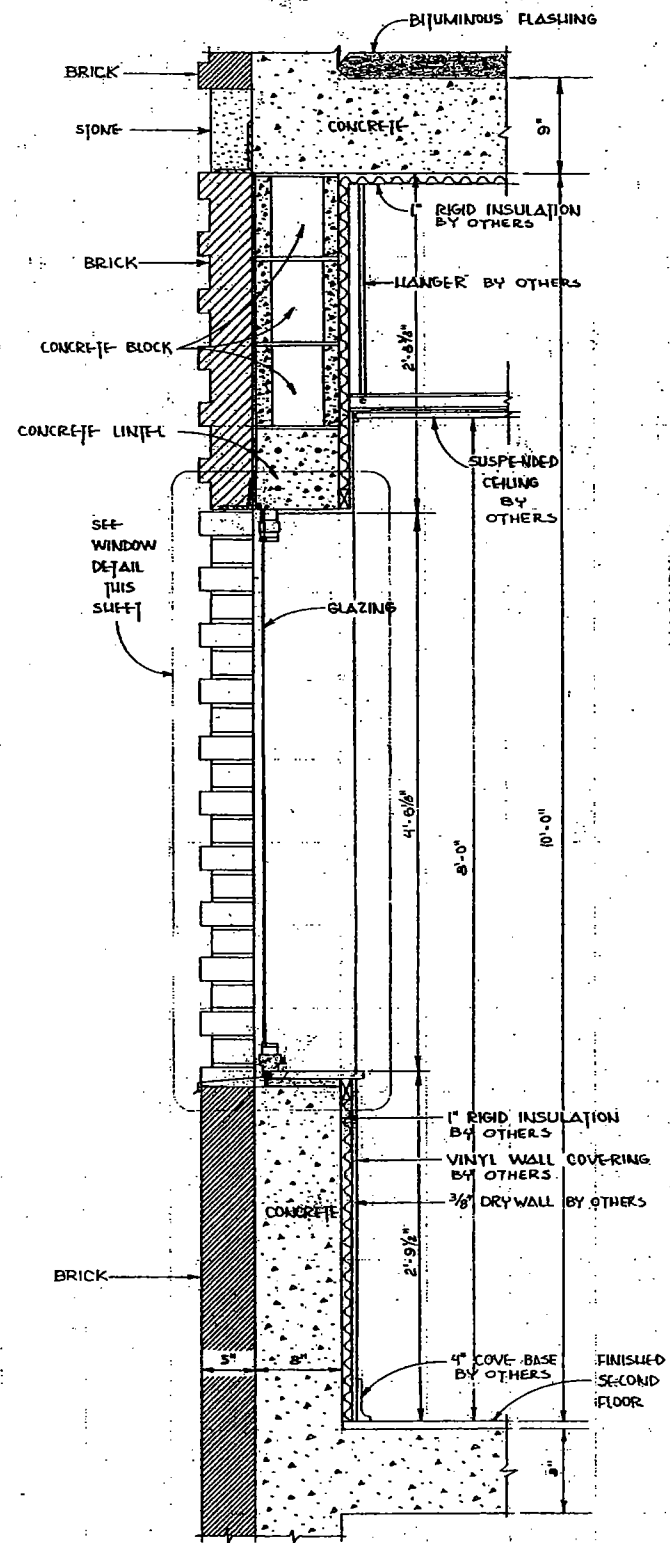
WEST ELEVATION
SCALE: $\frac{1}{8}" = 1'-0"$

EQUIPMENT SCHEDULE *							
SYMBOL	ITEM	MANUF'R	MASONRY OPENING H. X W.	MODEL	BTU/HR.	POWER	AMPERES
①	WINDOW TYPE-AIR CONDITIONER	COMFORT-AIRE	12 $\frac{1}{2}$ X 24 $\frac{1}{2}$	DUAL-AIRE WE-501	5000	115VAC, 1 ϕ , 60HZ	7.5
②	WINDOW TYPE-AIR CONDITIONER	FEDDERES	19 $\frac{1}{2}$ X 27 $\frac{1}{2}$	ACBIDE-3E	10000	230VAC, 1 ϕ , 60HZ	9.2
③	WINDOW TYPE-AIR CONDITIONER	GENERAL ELECTRIC	19" X 26 $\frac{1}{2}$ "	ES415BB	15000	230VAC, 1 ϕ , 60HZ	12.0
④	WINDOW TYPE-AIR CONDITIONER	GENERAL ELECTRIC	19" X 26"	DS418BB	18000	230VAC, 1 ϕ , 60HZ	13.9/14.1
⑤	WINDOW TYPE-AIR CONDITIONER	FEDDERES	19" X 26 $\frac{1}{2}$ "	ACL24E-3E	24000	230VAC, 1 ϕ , 60HZ	18.1
⑥	WATER-COOLED PACKAGED AIR CONDITIONER						
⑦	AUTOMATIC WALL FAN	NUTONE	2' X 9"	2090 W/V564 CONTROL	175 CFM	115VAC, 1 ϕ , 60HZ	

*NOTE: EQUIPMENT SCHEDULE ITEMS BY OTHERS, INFORMATION ONLY FOR MASONRY OPENINGS.

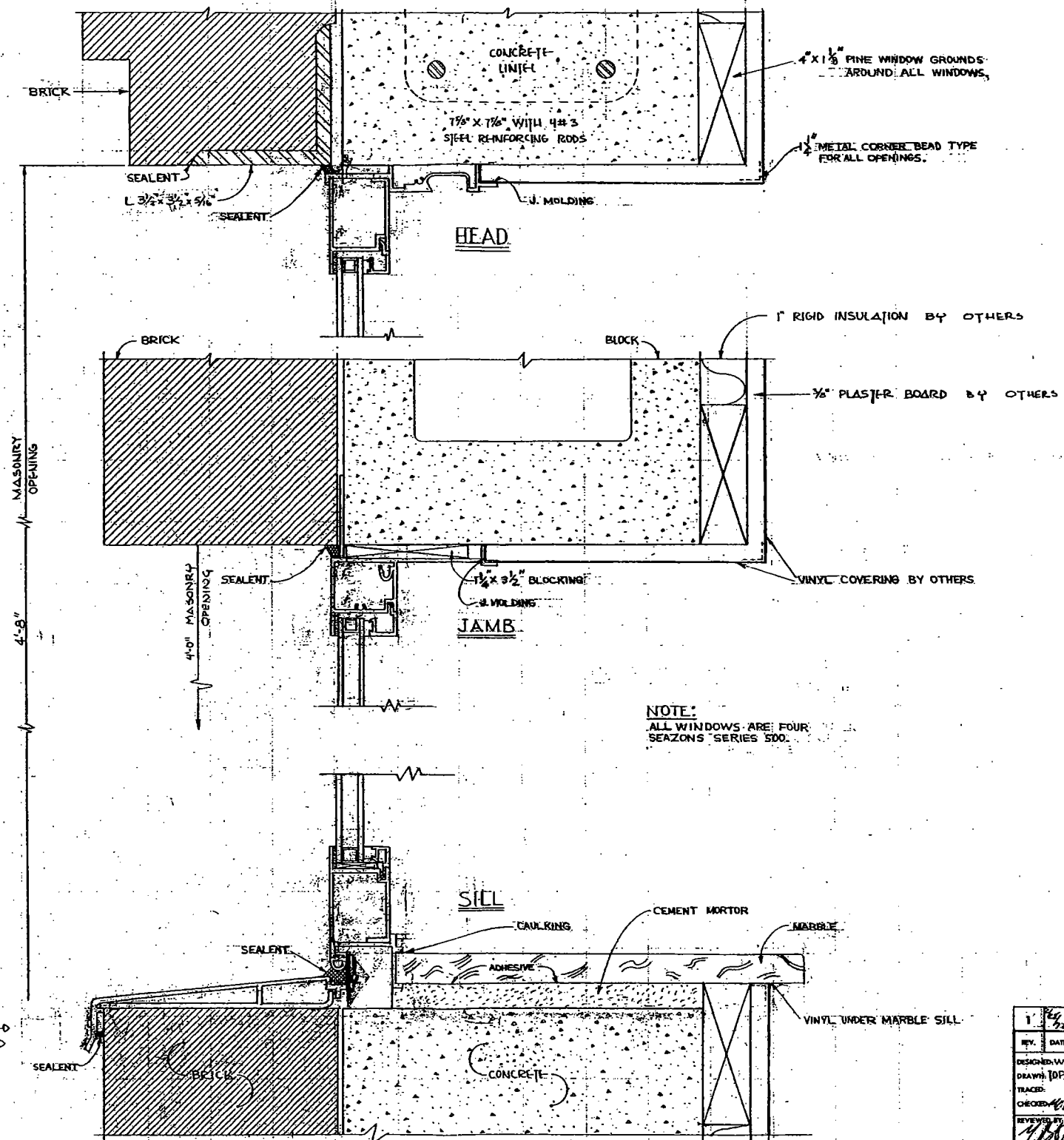


REV.	DATE	APPROVED	DESCRIPTION	BY
1	5/11/71	A. E. Kline	U.S. COAST GUARD, 9TH. DISTRICT, CLEVELAND, OHIO	K.M.
DESIGNED BY	B.K.		CIVIL ENGINEERING	
DRAWN BY	OPOLSKI		DETROIT RESERVE TRAINING (OBTUPS)	
TRACED BY			DETROIT	
CHECKED BY			EXTERIOR ELEVATIONS	
REVIEWED BY				
REVIEWED BY				
APPROVED				
DATE				
DRAWING NUMBER				
C/S 2077			2592-5	
SCALE	NOTED		SHEET 2 OF 12	



TYP. SECTION THROUGH WINDOWS.

SCALE 1/2" = 1'-0"



WINDOW DETAIL

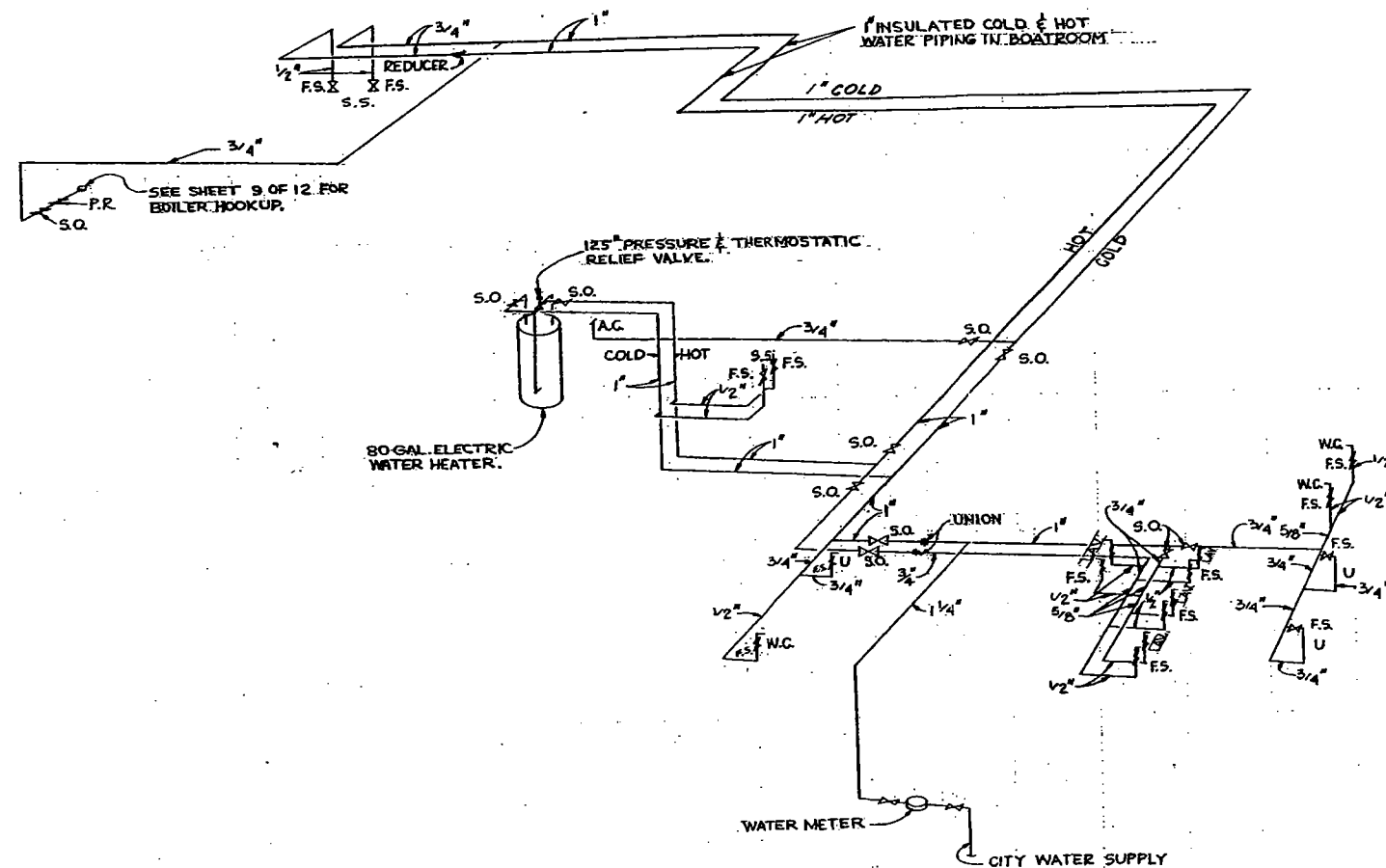
SCALE 3/8" = 1'-0"

NOTE:
ALL WINDOWS ARE FOUR SEASONS SERIES 500.

REV.	DATE	APPR.	DESCRIPTION	BY
1	6/2/77		DISBOLT EXTERIOR BRICKWORK, WINDOWS & FIRE ESCAPES BY CONTRACTOR DOT-CC69-6446 INTERIOR BY BASE DETROIT WING 104876	K.M.
DESIGNED BY	WOODWARD		U.S. COAST GUARD - 9TH DISTRICT - CLEVELAND, OHIO	
DRAWN BY	OPOLSKI		CIVIL ENGINEERING	
CHECKED BY	R.H.		DETROIT RESERVE TRAINING (ORTUPS)	
REVIEWED BY			DETROIT	MICHIGAN
REVIEWED BY			REMODELING	
REVIEWED BY			TYPICAL WALL SECTIONS AND MISCELLANEOUS DETAILS	
APPROVED BY			DATE	
			5/1/77	
DRAWING NUMBER			2592-5	
SCALE AS SHOWN			SHEET 3 OF 12	

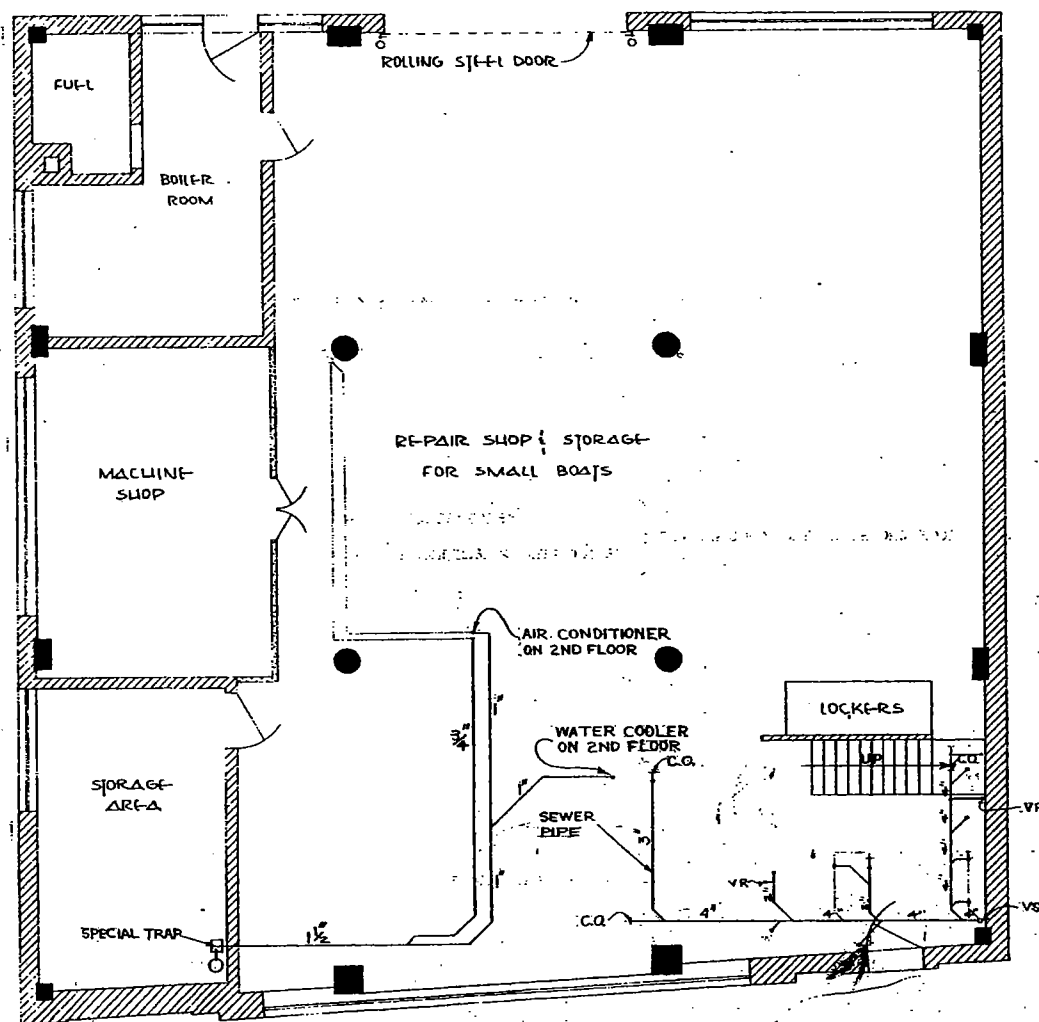
SYMBOLS

A.C.	AIR CONDITIONER
S.O.	SHUT-OFF
F.S.	FIXTURE STOPS
S.S.	SLOP SINK
P.R.	PRESSURE REGULATOR
U	URINAL
W.C.	WASTE CLOSET
LAV.	LAVATORY



HOT & COLD WATER PIPING
SCHEMATIC FLOW DIAGRAM
NO SCALE

1	2	3	4	5	6	7	8	9	10	11	12
REV.	DATE	APPR.	DESCRIPTION								BY
DESIGNED:	KANE		U.S. COAST GUARD, 9TH DISTRICT, CLEVELAND, OHIO								
DRAWN:	W.D.W.		CIVIL ENGINEERING								
CHECKED:			DETROIT RESERVE TRAINING (OFTOPS)								
REVIEWED BY:			DETROIT								
REVIEWED BY:			HOT & COLD WATER - PIPING								
REVIEWED BY:			SCHEMATIC FLOW DIAGRAM								
REVIEWED BY:			DATE								
REVIEWED BY:			APPROVED								
CHIEF OF DIVISION			DRAWING NUMBER								
9/3 2077			2592-0								
SCALE: NONE			SHEET 2 OF 12								



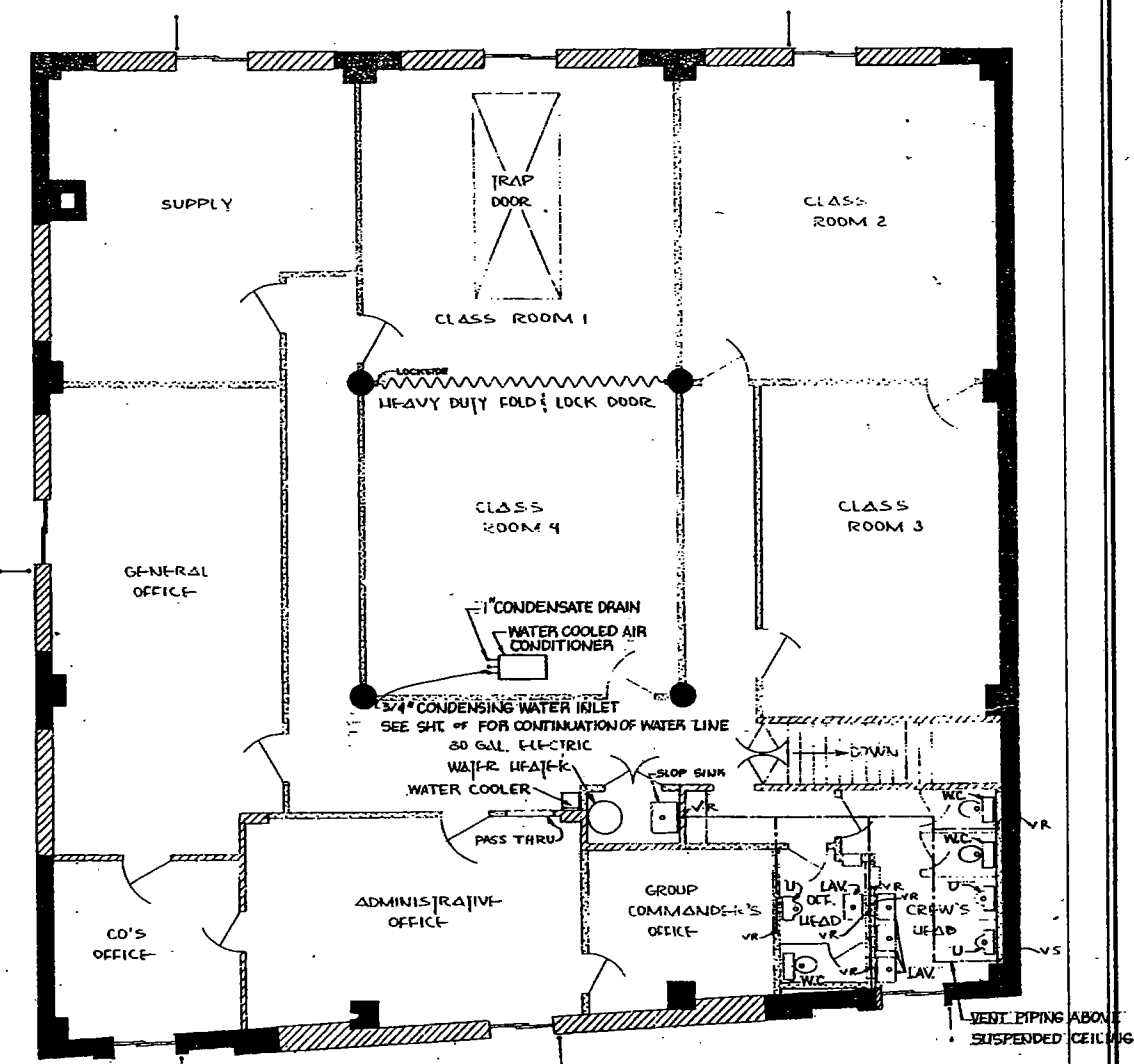
FIRST FLOOR PLAN

NOTE:
SLOPE HORIZONTAL SEWER LINE $\frac{1}{8}$ " TO $\frac{1}{4}$ " PER FOOT DOWNWARDS
TOWARDS OUTFLOW.

PIPING MATERIAL: 1" AND LARGER: PLASTIC PIPE WAS USED.
LESS THAN 3": STANDARD WEIGHT SEAMLESS GALVANIZED STEEL WITH
CAST IRON GALVANIZED DRAINAGE FITTINGS WITH
SCREWED ENDS.
C) SEALANT: USE TEFLON SEALANT AT THREADED CONNECTIONS.

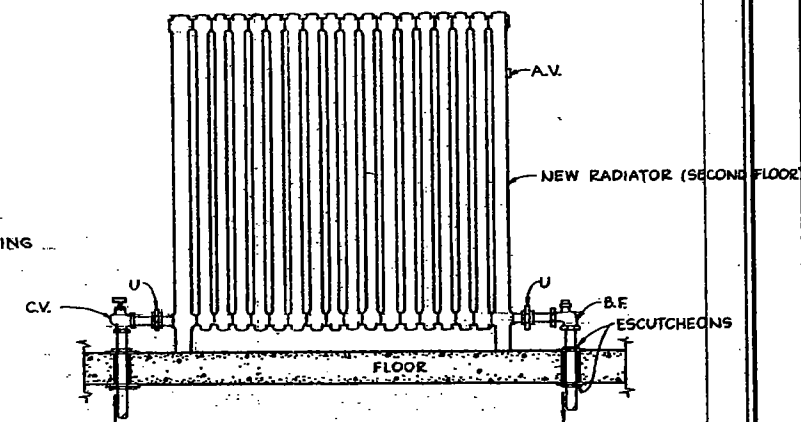
- EXISTING EXTERIOR WALLS AND INTERIOR COLUMNS
- EXISTING WINDOW OPENING
- 4" STUD PARTITIONS
- FOUR SEASONS SLIDING TYPE WINDOWS
- 6" STUD PARTITIONS
- BRICK
- FIRE ESCAPE LADDERS

- CO CLEAN-OUT
- WC WATER CLOSET
- U URINAL
- LAV LAVATORY
- VR VENT RISER
- VS VENT STACK

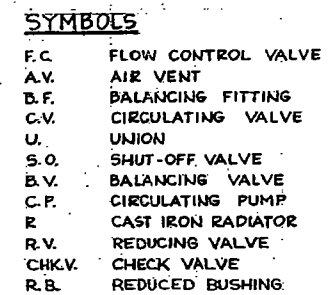


SECOND FLOOR PLAN

DESIGNED: KANE		DRAWN: TOPOLSKI		TRACED: W.D.W.		CHECKED: [Signature]		REVIEWED BY: [Signature]		REVIEWED BY: [Signature]		REVIEWED BY: [Signature]		APPROVED: [Signature]		DATE: 6/1/71			
"AS BUILT" BASE DETROIT WOND 3044-71 & 3048-71 U.S. COAST GUARD - 9TH DISTRICT - CLEVELAND, OHIO CIVIL ENGINEERING DETROIT RESERVE TRAINING (OR UPS) DETROIT SANITARY SEWER PIPING GENERAL ARRANGEMENT																			
C/S 2077												DRAWING NUMBER		2592-S		SHEET		7 OF 12	



SECOND FLOOR RADIATORS
TYPICAL PIPING ARRANGMENT
SCALE 1/2"=1'-0"



SECOND FLOOR HEATING SYSTEM
SCHEMATIC FLOW DIAGRAM
NO SCALE

1		2		3		4		5		6		7		8		9		10		11		12					
REV.		DATE		APPR.		DESCRIPTION										BY		J.M.									
DESIGNED, KANE		DRAWN, WALENCIAK				U.S. COAST GUARD 9TH DISTRICT CLEVELAND, OHIO																					
TRACED						CIVIL ENGINEERING																					
CHECKED, <i>ash</i>						DETROIT RESERVE TRAINING (ORTUPS)																					
REVIEWED BY, <i>ash</i>						DETROIT																					
REVIEWED BY,						HEATING SYSTEM																					
						SCHEMATIC FLOW DIAGRAM & DETAIL																					
REVIEWED BY,						APPROVED,																					
CHIEF OF DIVISION												DRAWING NUMBER															
c/s 2077												2592-3															
SCALE AS NOTED												SHEET 9 OF 12															

At Water
transfer document

DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C.

11/10/54
MAR 7 1955

MEMORANDUM FOR: COMMANDANT, U. S. COAST GUARD

SUBJECT: Transfer of U. S. Engineer Warehouse, 2640 East Atwater Street, Detroit, Michigan, to Coast Guard

1. Reference is made to your letter dated 27 December 1954, requesting the transfer of property, under the jurisdiction of this Department, located at 2640 East Atwater Street, Detroit, Michigan.
2. The property consists of the U. S. Engineer Warehouse building, together with a garage building, a marine garage and boathouse, a concrete dock, and approximately 1.256 acres of land on which the above-mentioned improvements are located.
3. Jurisdiction, custody, and control over the above-mentioned property is hereby transferred to the U. S. Coast Guard, without compensation therefor.
4. Authority of law for this transfer is contained in Title 14, United States Code, section 610.

(Signed: William H. ...)

Wilbur M. Brasher
Secretary of the Army

APPENDIX F

QUESTIONNAIRES AND CHECKLIST

Pre-Environmental Due Diligence Audit Questionnaire

Answer the following questions to the best of your knowledge. If a question does not apply, or if you are unsure of the answer, please indicate so in your response. If possible, please identify which participant responded to the question or set of questions. This will assist in the verification of suspected contamination during the site inspection, investigation, and interview process.

1. List all the personnel involved in the completion of this survey. Include names of any individuals who have experience in operations at your site. This list of contacts will be used to arrange interviews during the site inspection and investigation.

**Lt. Jason Kremer
Ray Emond**

2. What is the basis for the Agency's current real property interests at this location?

The site and buildings are currently used for storage and minor maintenance. (R. Emond)

3. Where is the property located (complete address, longitude/latitude, parcel number, or legal description if available)?

**2660 East Atwater Street
Detroit, Michigan 48207**

4. How large is the property (acreage)?

1.256 acres

5. Is the site located on or near any waterways, schools, or recreational facilities?

The site is located on the Detroit River.

6. Does the property contain new buildings, improvements, or other modifications since current owner's occupancy?

No.

7. How large are the new structures?

Not applicable.

8. What are the ages of the buildings?

There are currently two buildings on the site. Built in the 1930s, the six-car garage is a single story wood and brick structure. Built in 1932, the former Reserve Training Building is a two-story wood and brick building. (R. Emond)

9. How are the buildings being used?

Site and buildings are used as storage and minor maintenance. (R. Emond)

10. Who are the current owners and operators?

United States Coast Guard

11. Identify the main contacts for further inquiries.

Lt. Jason Kremer, Ray Emond

12. What are the current uses of the subject property?

Site and buildings are used as storage and minor maintenance. (R. Emond)

13. Who were the past owners and operators of the property?

United States Army Corps of Engineers (R. Emond)

14. What were the past uses of the property? (To the best of your knowledge)

USACE Officer's administrative offices (R. Emond)

15. Is the current owner or operator aware of any present or past underground or aboveground storage tanks located on or adjacent to the subject property?

There is evidence of a former Aboveground Storage Tank at the Southwest corner of the site.

16. If yes, can the owner/ operator demonstrate that the tanks have been properly closed, installed, certified or that existing tanks are not currently leaking?

According to R. Emond, the AST was removed (No date given) and properly disposed of. Electrical panel and some piping remain with former pad.

17. If underground storage tanks (USTs) or aboveground storage tanks (ASTs) exist, complete the UST questionnaire in Appendix L.

18. Is the owner/ operator aware of any landfill (public or private) operators on or adjacent to the subject property?

No.

19. If yes, identify the waste types that were disposed of within the landfill.

Not Applicable.

20. Is the owner/ operator aware of any hazardous substances (e.g., polychlorinated biphenyls (PCBs), asbestos) in any structures, equipment (electrical/mechanical), or on the premises?

The owner/operator is not aware of any hazardous substances in any structures or equipment on the premises. No insulation is visible in the walls or ceiling. Pipe is wrapped with insulation but could not gain access to determine if asbestos or not. Ceiling tile was sampled for asbestos and results were negative.

NOTES (list number of question for comment continuation)

Site Visit Guidelines

The guidelines below can be used in performing a site visit during Phase I of the environmental due diligence process (EDDA). Answers to the questions can be helpful in identifying potential environmental issues that should be addressed before transferring real property.

General Information

1. Is the property located in an area designated as a wetland, wilderness, or historical area?

No.

2. Are any rivers, streams, springs, lakes, or ponds located near or on the property?

Site is located on the Detroit River. The river is the only major hydrologic feature at the site.

3. What are the zoning requirements or intended future use for the property?

Surrounding properties are commercial/industrial. There are no immediate plans for the property; however, the site neighbors the properties where casinos will be built. The City of Detroit is redeveloping the entire waterfront. The site could be used for anything from a parking lot, to a boat dock, to residential condominiums or apartments.

Adjacent Property

4. What are the zoning requirements or intended future use for adjacent properties?

See above

5. Who are the adjacent property owners? What activities take place at all adjacent properties (e.g., commercial tenants handling hazardous waste, military or industrial research, machinery repair, landscaping, mining/quarrying, oil/gas extraction, manufacturing, agriculture)?

A parking lot for a boat dock/boat touring service borders the site on the northeast and a bulk aggregate facility on the southwest.

6. Who are the adjacent property main contacts for further inquiries and coordination?

Unknown.

7. Is the current owner/operator aware of any present or past underground or aboveground storage tanks being located adjacent to the subject property? If yes, can the owner/operator demonstrate that the tanks have been properly closed, installed, certified or that existing tanks are not currently leaking? If underground storage tanks (USTs) or aboveground storage tanks (ASTs) exist complete UST questionnaire in Appendix O.

Both present and past underground storage tanks are located near the subject property. One property with two USTs is within a quarter-mile radius of the subject site.

Records and Documents

8. Is (or has been) the subject property on the National Priorities List (NPL) of Superfund sites? *The Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS) reports can be obtained from the Resource Conservation and Recovery Act (RCRA)/Superfund Industry Assistance Hotline (800-424-9810), the CERCLIS Helpline (202-260-0056), the EPA Regional Office, or from the state environmental agency.*

No, the subject property was not listed on the NPL.

9. Have or are nearby properties (within two miles of the site) been on the NPL?

No properties within one mile of the site have been on the NPL.

10. Have there been any fuel leaks in the area? *The State Environmental Agency Site Lists, which is similar to CERCLIS, contain information on smaller fuel leak sites.*

Fourteen leaking USTs have been reported within a half-mile radius of the subject site.

Permits, Surveys, Violations

11. Has the facility possessed any environmental permits in the past or present? Indicate Y/N. ☐N air quality; ☐N hazardous waste treatment, storage or disposal facility; ☐N public owned treatment works; ☐N sanitary sewer; ☐N USTs ☐N National Pollutant Discharge Elimination System; ☐N stormwater discharge

Both storm water runoff and wastewater go through the City of Detroit sewers.

12. Has the facility been cited for permit violations or environmental noncompliances? If yes, provide a brief description of all violations or noncompliance.

No

13. Have soil or groundwater studies been performed on the subject property or adjacent properties? *These reports and test results should be available from the owner/operator of the properties.*

No previous environmental studies have been conducted at the subject property.

14. Does the local fire department have record of any violations (impacting human health and the environment) of the owner/operator facility? Provide a list or brief description.

There are no files indicating any past violations.

15. Has an indoor air quality survey been performed recently? If so, when and what were the results?

No.

16. Has a radon survey been performed recently? If so, when and what were the results?

No. One site within Wayne County has been tested. The average activity in the basement was 1.3 pCi/L.

17. Has a radiological survey been performed recently? If so, when and what were the results?

No.

18. Has an asbestos inspection or survey been performed at the facility before or during occupancy? Are reports available documenting the inspection results? Briefly describe the results or provide the inspection report. *The report can be obtained from the owner or operator of the facility.*

Yes, an asbestos survey was performed on April 3, 1997. The ceiling tile was sampled and found to be asbestos-free.

19. Has an UST survey been performed by a qualified engineer? If so, when and what were the results?

Does not apply.

20. Were aerial photographs taken prior to the Agency occupying the property? *The United States Geological Survey (USGS) in Reston, Virginia, maintains aerial photographs of the United States.*

Yes, the USCG obtained the property from the USACE in 1957. An aerial of the property was taken in 1937.

21. Has a lead-based paint survey been performed recently? If so, when and what were the results?

Some lead-based paint testing was done April 3, 1997 and all samples were positive for lead based paints.

22. Has a RCRA facility assessment or investigation been performed in the past or present? Provide a brief description.

No.

Hazardous Materials Usage/Releases

23. Are any automotive or industrial batteries or paints handled or used in large volumes greater than five gallons?

No.

24. Are any industrial drums (15-55 gallons) used, handled, or stored at the facility? If so approximately how many?

No.

25. Was the site ever used for or by commercial tenants handling hazardous waste, military or industrial research, machinery repair, landscaping, mining/quarrying, oil/gas extraction, manufacturing, or agriculture?

The site is a former USCG MSO station. Site and buildings are now used for storage and minor maintenance.

26. Are hazardous substances disposed of on-site, injected into groundwater, or discharged into drains, septic systems, ponds, or lagoons?

No. In the past, waste was disposed of by the City of Detroit waste disposal unit.

27. Are there any ponds or collection pits on-site? If yes, what do they contain?

No.

28. Are the signs of stressed vegetation (browened, burned out) or stained soil?

No.

29. Are any leaks, spills, or stains present on the property or in any buildings?

Ground level, wooden floor shows some minor staining, which may be due to flooding or minor spills during maintenance.

30. What hazardous materials are or have been used, treated, or otherwise handled on-site? *This information can be obtained from material safety data sheets (MSDS) or from the local fire department.*

There are no hazardous materials used in large quantities. The USCG has done some minor marine engine repair at the site, which may have required the use of degreasers or solvents, but there was no evidence of spills. No work has been done there since the USCG moved to their new station.

31. Has there been any history of hazardous or municipal solid waste disposal on-site?

No.

32. Have there been on-site or off-site releases?

No.

33. Are there any drinking water or groundwater monitoring wells on-site?

No.

Storage Tanks

34. Have or are wells, dry wells, or septic tanks operating? Are there any abandoned wells or septic tanks?

No.

35. Are any underground storage tanks on the property, close proximity to the subject property facility, or on the adjacent property? If yes, complete the UST questionnaire in Appendix O.

Yes, there are two USTs on a property within one-quarter mile of the subject property.

36. Are any aboveground storage tanks on or near the property? If so, describe the construction, age, capacity, and contents of the tank(s).

There is evidence of a former Aboveground Storage Tank at the Southwest corner of the site. According to Ray Emond the Tank was removed (date unknown) and properly disposed of. Electrical panel and some piping remain with former pad.

37. Is there staining around any of the storage tanks?

No.

38. Does the AST have secondary containment?

The former concrete pad is still located at the site. There was no spill containment, but the pad showed no signs of spills (i.e. no staining) and the pad was in good condition with no crack or breaking which would have allowed any seeping of a minor spill.

Polychlorinated Biphenyl (PCB) Transformers

39. Are any of the following transformers on-site? Indicate Y or N. **No** electrical transformer; **No** electrical capacitors; **No** hydraulic systems; **No** waste oil tank; **No** other (specify)

40. Has or is any of the equipment leaking or damaged? If leaks or damages have occurred in the past, provide a brief description of the incident and actions taken.

Not applicable.

Asbestos

41. When was each building on-site constructed? *Note any construction prior to 1987 that may contain asbestos.*

The building was constructed in 1932, and the garage was also constructed in the 1930s.

Pesticides

42. Are or were pesticides used, stored, or manufactured at the site?

The site is predominantly covered with asphalt. A small green belt is located on the eastern side of the building and was used as a planter for landscape purposes. Thus, any pesticide use would be very limited.

43. Has there ever been a spill of pesticides at the site?

Probably not.

Radioactive Materials and Waste

44. Are or were radioactive materials used, stored, or manufactured at the site? Is a Nuclear Regulatory Commission (NRC) license available for review?

No.

45. Has there ever been a radioactive materials release or violation at the site?

No.

46. What engineering controls for radioactive materials are or have been used?

Not Applicable.

47. Is or has a liquid radioactive waste storage and treatment system been operated at the facility?

No.

48. Is or has liquid radiological waste been discharged to the sanitary sewers?

No.

49. Were or are radiological materials used, or stored in rooms, areas or work surfaces constructed of porous materials, tile floors, concrete, or other surfaces with cracks, crevices, and seams?

No.

Laboratory Operations, Analysis, and Experiments

50. Are or have experiments been conducted in the soils, groundwater, man-made streams, or sediments at the site? Provide a brief description of each experiment.

No.

51. What laboratory bench or pilot-scale operations or experiments have been or are conducted that involve engineering systems or equipment exposure to hazardous materials? Provide a description of each.

No.

52. What treatment systems have been or are in operation including, but not limited to, waste water, water, incinerators, solvent recovery/recycling, elementary neutralization, sanitary?

None.

53. Are or have laboratory activities been conducted in temporary structures or mobile trailers? Provide a description of the structure and associated activities.

No.

54. Are there on-site mobile equipment or temporary structures on site that may require removal, decommissioning, shutdown, or decontamination because of exposure to hazardous or radiological materials? Provide a list and brief description.

No.

NOTES (list number of question for comment continuation)

PHASE I - SITE RECONNAISSANCE CHECKLIST

Method Used to Observe Property

Site Walk Over

Access/Observation Limitations

Locked gate.

Date

May 10, 2001

Project No.

N3843

Project Name

USCG - Detroit Atwater Site

Address/Location

A. Bennett

TtNUS Personnel

Key Site Manager

Lt. Jason Kremer

Phone No.

313-568-9569

Other Interviewees

Ray Emond

	Observations	Photo	Interviewees
1. GENERAL SITE SETTING Current and Past Use(s) Property Adjoining Properties Surrounding Area	Site is former USCG MSO station. Operations ceased in 1993. Site and buildings are used as storage and minor maintenance. Property to East is parking lot for boat dock/touring, to the West is a bulk aggregate facility with 3-4 large silos, to the South is the	yes	R. Emond
Site Topography	Site is flat. Gently sloping South towards the Detroit River. Covered with Asphalt.	yes	R. Emond
Site Hydrology Streams Ponds Springs/Seeps Surface Water Flow	Site is located on the Detroit River. The river is the only major Hydrologic feature at the site.	yes	R. Emond
Site Geology/Hydrogeology Sinkholes Outcrops Mining Activity Groundwater (depth)	Site is flat and covered with asphalt. Site gently slopes toward the Detroit River.	yes	R. Emond
Structure - General Description No. of Buildings Building Sizes Dates of Construction General Condition	There are currently two bldgs. Located on the site. Built in the 1930s, the garage is a single story wood and brick structure. The main building at the site is a two story wood and brick building. Both structures are in decent condition. The site is maintained by the crew at the USCG-Detroit station.	yes	R. Emond
Site Surface Cover Vegetation (type) Manmade (type)	The site is predominantly covered with asphalt. A small green belt is located on the east side of the building and was used as a planter for landscape purposes.	yes	R. Emond
Roads Adjoining Thoroughfares Streets, Roads, Paths Usage (outlet, public access) Parking Facilities	The main route to and from the station is Atwater Street which runs along the Northern edge of the property. A locked gate is the only entrance to the property. The Detroit River forms the Southern Boundary of the site and could also be used to gain access to the site.	yes	R. Emond
Potable Water Supply Source	Water is supplied by the City of Detroit, but all water has been shut off to the site.		R. Emond
Sewage Disposal System Type Age	Sewage is disposed of through the City of Detroit sewer system.		R. Emond

PHASE I - SITE RECONNAISSANCE CHECKLIST

Method Used to Observe Property Site Walk Over

Access/Observation Limitations Locked gate.

Date May 10, 2001
 Project No. N3843
 Project Name USCG - Detroit Atwater Site
 Address/Location _____
 TtNUS Personnel A. Bennett
 Key Site Manager Lt. Jason Kremer
 Phone No. 313-568-9569
 Other Interviewees Ray Emond

2. INTERIOR/EXTERIOR OBSERVATIONS			
Aboveground Storage Tanks Old pads, piping, evidence of former tanks How many? Location Contents Condition of tanks	There is evidence of a former Aboveground Storage Tank at the Southwest corner of the site. According to R. Emond the Tank was removed (No date given) and properly disposed of. Electrical panel and some piping remains with former pad.	yes	R. Emond
Underground Storage Tanks Vent pipes, fill pipes, pump pads How many? Location Contents Condition of piping/pumps?	None		R. Emond
Odors Description Source	No odors observed on exterior of building. Interior had slight hydrocarbon smell. Probably due to storage of boat motors and minor maintenance activities. Also a mildew smell due to age and a past flood of the building.		R. Emond
Drums Labels How many? Condition Size Leaking?	None		R. Emond
Miscellaneous Containers Contents How many? Condition Storage Facilities Spill Containment	None. There are no chemicals or containers stored at the site. All items stored at the site are building material, old buoys, and boat motors.		R. Emond
PCB Items Electrical Equipment (transformers) Hydraulic Equipment Type Condition Storage Facilities Spill Containment	None		R. Emond

PHASE I - SITE RECONNAISSANCE CHECKLIST

Method Used to Observe Property Site Walk Over

Access/Observation Limitations Locked gate.

Date May 10, 2001
 Project No. N3843
 Project Name USCG - Detroit Atwater Site
 Address/Location _____
 TiNUS Personnel A. Bennett
 Key Site Manager Lt. Jason Kremer
 Phone No. 313-568-9569
 Other Interviewees Ray Emond

3. INTERIOR OBSERVATIONS					
Heating / Cooling Systems			Boiler room located in Northeast corner of building. Gas boiler to heat water for hot water radiant heat.	yes	R. Emond
Type		Fuel Source			
Boiler Room		Exhaust			
Stains / Corrosion			Ground level floor shows some minor staining. Floor is wood so it may be due to flooding, or minor spills during maintenance. Ceiling and columns have peeling paint. Paint samples were collected and analyzed for Lead.	yes	R. Emond
Floors		Walls			
Ceilings		Sources			
Drains / Sumps			There is a floor drain located in the boiler room and in the main room of the building. Both discharge to the City Sewer system.	yes	R. Emond
Discharge Where?					
Flooring Material			Floor in garage is concrete. Floor in former maintenance building is a 2"x4" treated wood block adhered to concrete. Second floor is carpet over concrete.	yes	R. Emond
Insulation Type			No insulation visible in walls or ceiling. Pipe is wrapped with insulation but could not gain access to determine if asbestos or not. Ceiling tile was sampled for asbestos and results were negative.	yes	R. Emond
Asbestos					
Fiberglass					
Other?					
Process Equipment			None		R. Emond
Paint Booths					
Dip Tanks					
Cleaning Units / Degreasers					
Plating					

PHASE I - SITE RECONNAISSANCE CHECKLIST

Method Used to Observe Property Site Walk Over

Access/Observation Limitations Locked gate.

Date May 10, 2001

Project No. N3843

Project Name USCG - Detroit Atwater Site

Address/Location _____

TtNUS Personnel A. Bennett

Key Site Manager Lt. Jason Kremer

Phone No. 313-568-9569

Other Interviewees Ray Emond

4. EXTERIOR OBSERVATIONS			
Pits, Ponds, Lagoons		None	
Location	Type of Construction		
Age	Size		R. Emond
Condition	Contents		
Spill Containment			
Stained Soil / Pavement		None	
Description			R. Emond
Source?			
Stressed Vegetation		None	
Description			
Location			R. Emond
Amount			
Herbicides/Pesticide Use?			
Solid Waste Disposal (Landfill, Waste Piles, Incinerators)		Currently there is no waste disposal for the site. In the past waste was disposed of by the City of Detroit waste disposal unit.	
Evidence of landfill (mounds, excavations, depressions, ash/burning)			
Off site disposal (dumpsters, containers)			
Location			R. Emond
Size			
Condition			
Discharge? To What?			
Pollution Control			
Leakage?			
Wastewater/Stormwater		All wastewater/stormwater is disposed of through the City of Detroit system. No manholes or drains found on exterior of site. All stormwater probably ran off to river.	
Drains / Sumps			
Discharge Where?			R. Emond
Manholes			
Wastewater Treatment			
Ditches, Streams			
Oil / Water Separators			
Wells		None	
Type (dry, water, injection, irrigation, oil/gas, monitoring, abandoned)			R. Emond
Condition			
Location			
Onsite Septic System		None	
Type			R. Emond
Condition			
Pipelines		None	
Location	Size		
Type	Construction		R. Emond
Age	Depth		
Air Emissions		None	
Exhaust			
Vents			
Stacks			R. Emond
Incinerators			
Pollution Control?			

APPENDIX G

FIELD FORMS

APPENDIX G.1

BORING LOGS

PROJECT NAME: USCG Detroit Atwater
PROJECT NUMBER: 3843.099A
DRILLING COMPANY: ISI
DRILLING RIG: GEOPROBE

BORING NUMBER: DASB010607
DATE: 08/14/02
GEOLOGIST: SUNIL KULKARNI
DRILLER: TONY SAPLING

[illegible]

* When rock coring, enter rock brokenness.

**** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.**

Remarks: PID BATTERY WAS DEAD.

Drilling Area B
Background (ppm): N/A

Converted to Well: Yes No ☒ Well I.D. #:

BORING LOG

PROJECT NAME: USCG Detroit Atwater
PROJECT NUMBER: 3843.099A
DRILLING COMPANY: ISI
DRILLING RIG: Geoprobe

BORING NUMBER: DASB020607
DATE: 08/14/02
GEOLOGIST: SUNIL KULKARNI
DRILLER: TONY SAPLING

[illegible]

* When rock coring, enter rock brokenness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks:

Drilling Area
Background (ppm): N/A

Converted to Well: Yes No ☒ Well I.D. #:

PROJECT NAME: USCG Detroit Atwater
PROJECT NUMBER: 3843.099A
DRILLING COMPANY: ISI
DRILLING RIG: GEOPROBE

BORING NUMBER: DASB030406
DATE: 08/14/02
GEOLOGIST: SUNIL KULKARNI
DRILLER: TONY SAPLING

[illegible]

* When rock coring, enter rock brokenness.

**** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.**

Remarks:

Drilling Area
Background (ppm): N/A

Converted to Well: Yes No ☒ Well I.D. #:

PROJECT NAME: USCG Detroit Atwater

PROJECT NUMBER: 3843.099A

DRILLING COMPANY: ISI

DRILLING RIG: GEOPROBE

BORING NUMBER: DASB06112

DATE: 08/14/02

GEOLOGIST: SUNIL KULKARNI

DRILLER: TONY SAPLING

[illegible]

* When rock coring, enter rock brokenness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks:

Drilling Area
Background (ppm): n/a

Converted to Well: Yes

No

Well I.D. #:

BORING LOG

PROJECT NAME: USCG Detroit Atwater
PROJECT NUMBER: 3843.099A
DRILLING COMPANY: ISI
DRILLING RIG: GEOPROBE

BORING NUMBER: DASB070304
DATE: 08/14/02
GEOLOGIST: SUNIL KULKARNI
DRILLER: TONY SAPLING.

[illegible]

* When rock coring, enter rock brokenness.

**** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.**

Remarks:

Drilling Area
Background (ppm): N/A

Converted to Well: Yes ☐ No ☒ Well I.D. #: _____

BORING LOG

PROJECT NAME:	USCG Detroit Atwater	BORING NUMBER:	DASB080304
PROJECT NUMBER:	3843.099A	DATE:	08/14/02
DRILLING COMPANY:	ISI	GEOLOGIST:	SUNIL KULKARNI
DRILLING RIG:	GEOPROBE	DRILLER:	TONY SAPLING

[illegible]

* When rock coring, enter rock brokenness.

**** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.**

Remarks:

Drilling Area
Background (ppm): N/A

Converted to Well: Yes ☐ No ☒ Well I.D. #: _____

PROJECT NAME:	USCG Detroit Atwater
PROJECT NUMBER:	3843.099A
DRILLING COMPANY:	ISI
DRILLING RIG:	GEOPROBE

BORING NUMBER: DASB090304
DATE: 08/14/02
GEOLOGIST: SUNIL KULKARNI
DRILLER: TONY SAPLING

[illegible]

* When rock coring, enter rock brokenness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks:

Drilling Area
Background (ppm):

Converted to Well: Yes ☐ No ☒ Well I.D. #: _____

APPENDIX G.2

SOIL SAMPLE LOG SHEETS

Project Site Name:	<u>USCG - ATWATER DETROIT</u>	Sample ID No.:	<u>DASB010607</u>
Project No.: 2	<u>3843-099A</u>	Sample Location:	<u>S801</u>
		Sampled By:	<u>SK</u>
		C.O.C. No.:	<u> </u>
<input type="checkbox"/> Surface Soil <input checked="" type="checkbox"/> Subsurface Soil <input type="checkbox"/> Sediment <input type="checkbox"/> Other: <u> </u> <input type="checkbox"/> QA Sample Type: <u> </u>		Type of Sample: <input checked="" type="checkbox"/> Low Concentration <input checked="" type="checkbox"/> High Concentration	

GRAB SAMPLE DATA:

Date: 08/14/02	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time: 1240	6-7' Below (4-5' BGS) ²¹⁶	BROWN	SILTY CLAY
Method: GEOPROBE			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

[illegible]

SAMPLE COLLECTION INFORMATION:

[illegible]**OBSERVATIONS / NOTES:**

FIGURE 2-2 :
IN FORMER OIL & GAS
STORAGE AREA.

Circle If Applicable:

MS/MSD	Duplicate ID No. DAFDOI0607	Signature (s): 
--------	--------------------------------	--

Project Site Name: _____		USCG DETROIT ATWATER		Sample ID No.: <u>DASB 02 0607</u>	
Project No.: _____		N3843-099A		Sample Location: <u>DASB 02</u>	
<input type="checkbox"/> Surface Soil <input checked="" type="checkbox"/> Subsurface Soil <input type="checkbox"/> Sediment <input type="checkbox"/> Other: _____ <input type="checkbox"/> QA Sample Type: _____				Sampled By: <u>SK</u> C.O.C. No.: <u> </u>	
				Type of Sample: <input checked="" type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration	

GRAB SAMPLE DATA:			
Date: <u>08/14/02</u>	Depth: <u>6-7' BELOW RIG</u> <u>(4.5-5.5 RGS)</u>	Color: <u>BROWN</u>	Description (Sand, Silt, Clay, Moisture, etc.): <u>SILTY CLAY</u>
Time: <u>1255</u>			
Method: <u>DPT</u>			
Monitor Reading (ppm): <u>N/A</u>			

COMPOSITE SAMPLE DATA:				
Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:			
Analysis	Container Requirements	Collected	Other
BTEX and MTBE <input checked="" type="checkbox"/>	<u>3 - VIALS</u>	<u>3</u>	
PAHs <input checked="" type="checkbox"/>	<u>1 - JAR</u>	<u>1</u>	
Lead <input checked="" type="checkbox"/>	<u>1 - JAR</u>	<u>1</u>	
VOCs			
SVOCs			
Pest/PCBs			

OBSERVATIONS / NOTES:	MAP:
	<p>FIGURE 2-2</p> <p>IN FORMER OIL & GAS STORAGE AREA</p>

Circle If Applicable:		Signature(s):
MS/MSD	Duplicate ID No.: _____	



Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name:	USCG DETROIT ATWATER	Sample ID No.:	DASB030406
Project No.:	N3843-099A	Sample Location:	DASB03
<input type="checkbox"/> Surface Soil		Sampled By:	SK.
<input checked="" type="checkbox"/> Subsurface Soil		C.O.C. No.:	N/A
<input type="checkbox"/> Sediment		Type of Sample:	
<input type="checkbox"/> Other:		<input checked="" type="checkbox"/> Low Concentration	
<input type="checkbox"/> QA Sample Type:		<input checked="" type="checkbox"/> High Concentration	

GRAB SAMPLE DATA:

Date:	08/14/02	Depth:	4-6' below RIG	Color:	GRAY	Description (Sand, Silt, Clay, Moisture, etc.):	SILTY CLAY, SOFT
Time:	1230						
Method:	DPT						
Monitor Reading (ppm):	N/A		(1-3' BGS)				

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
BTEX and MTBE ✓	3-VIAL	3	
PAHs ✓	1-JAR	1	
Lead ✓	1-JAR	1	
VOCs			
SVOCs			
Pest/PGBs			

OBSERVATIONS / NOTES:

MAP:

	FIGURE 2-2: IN FORMER OIL & GAS STORAGE AREA.
--	---

Circle if Applicable:

Signature(s):

MS/MSD	Duplicate ID No.:	
--------	-------------------	--



Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page 1 of 1

Project Site Name: USCG DETROIT ATWATER
Project No.: N3843-099A

Sample ID No.: DASB 061112
Sample Location: DASB06
Sampled By: SK
C.O.C. No.: N/A

- ☐ Surface Soil
☒ Subsurface Soil
☐ Sediment
☐ Other:
☐ QA Sample Type: _____

Type of Sample:
☒ Low Concentration
☐ High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
08/14/02	11-12' ^{below} RIG	BRN/GRAY	FINE-MED SAND & SILTY SAND
Time: 850	(8.5-9' AG)		
Method: DPT			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
BTEX and MTBE ✓	3-VIAL	3	
PAHs			
Lead ✓	1-JAR	1	
VOCs			
SVOCs			
Pest/PCBs			

OBSERVATIONS / NOTES:

MAP:

FIGURE 2-2
IN FORMER AST AREA.

Circle if Applicable:

MS/MSD

Duplicate ID No.:

Signature(s):



Project Site Name:	USCG DETROIT ATWATER	Sample ID No.:	DASB070304
Project No.:	N3843-099A	Sample Location:	DASB07
<input type="checkbox"/> Surface Soil		Sampled By:	SK
<input checked="" type="checkbox"/> Subsurface Soil		C.O.C. No.:	
<input type="checkbox"/> Sediment		Type of Sample:	
<input type="checkbox"/> Other:		<input checked="" type="checkbox"/> Low Concentration	
<input type="checkbox"/> QA Sample Type:		<input checked="" type="checkbox"/> High Concentration	

GRAB SAMPLE DATA:

Date:	08/14/02	Depth:	3-4' below RG (1-2' BES)	Color:	BLACK	Description (Sand, Silt, Clay, Moisture, etc.):	POWDERY FILL MATERIAL
Time:	1425						
Method:	DPT						
Monitor Reading (ppm):							

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
BTEX and MTBE			
PAHs			
Lead			
VOCs	3-VIALS	3	
SVOCs	1-JAR	1	
Pest/PCBs	2-JARS	2	
PERA METALS	1-JAR	1	

OBSERVATIONS / NOTES:

MAP:

SLIGHT HYDROCARBON (H.C.)
ODOR

FIGURE 2-2
IN PARKING AREA TO THE
NORTH OF FORMER BRICK BLDG.

Circle if Applicable:

Signature(s):

MS/MSD

Duplicate ID No.:



Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page ___ of ___

Project Site Name:	USCG DETROIT ATWATER	Sample ID No.:	DASB080304
Project No.:	N3843-099A	Sample Location:	DASB 08
		Sampled By:	SK
		C.O.C. No.:	
<input type="checkbox"/> Surface Soil <input checked="" type="checkbox"/> Subsurface Soil <input type="checkbox"/> Sediment <input type="checkbox"/> Other: <input type="checkbox"/> QA Sample Type:		Type of Sample: <input checked="" type="checkbox"/> Low Concentration <input type="checkbox"/> High Concentration	

GRAB SAMPLE DATA:

Date:	08/14/02	Depth:	3-4' below RIC	Color:	BLACK	Description (Sand, Silt, Clay, Moisture, etc.):	FINE - COARSE SAND
Time:	935						
Method:	DPT						
Monitor Reading (ppm):			12-3' BGS				

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
BTEX and MTBE			
PAHs			
Lead			
VOCs ✓	3-VIALS x 2	6	
SVOCs ✓	1-JAR	1	
Pest/PCBs ✓	2-JARS	2	
RLRA METALS ✓	1-JAR x 2	2	
DUPLICATE ON VOCs + RLRA METALS			

OBSERVATIONS / NOTES:

MAP:

STRONG H.C. ODOR.

FIGURE 2-2

IN PARKING AREA, TO THE NORTH
OF FORMER BRICK BLDG.

Circle if Applicable:

Signature(s):

MS/MSD

Duplicate ID No.:

DSDFO20304



Project Site Name:	USCG DETROIT ATWATER	Sample ID No.:	DASB090304
Project No.:	N3843-099A	Sample Location:	DASB09
<input type="checkbox"/> Surface Soil		Sampled By:	SK
<input checked="" type="checkbox"/> Subsurface Soil		C.O.C. No.:	
<input type="checkbox"/> Sediment		Type of Sample:	
<input type="checkbox"/> Other:		<input checked="" type="checkbox"/> Low Concentration	
<input type="checkbox"/> QA Sample Type:		<input checked="" type="checkbox"/> High Concentration	

GRAB SAMPLE DATA:

Date:	08/14/02	Depth:	3-4' below (1-2' RES) RIG	Color:	BLACK	Description (Sand, Silt, Clay, Moisture, etc.):	FILL MATERIAL w/ PEAT.
Time:	1320						
Method:	DPT						
Monitor Reading (ppm):							

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
BTEX and MTBE			
PAHs			
Lead			
VOCs	3 - VIALS		
SVOCs	1 - JAR		
Pest/PCBs	2 - JARS		
PERA METALS	1 - JAR		

OBSERVATIONS / NOTES:

MAP:

	FIGURE 2-2 IN THE PARKING LOT, TO THE NORTH OF FORMER BRICK BLDG.
--	---

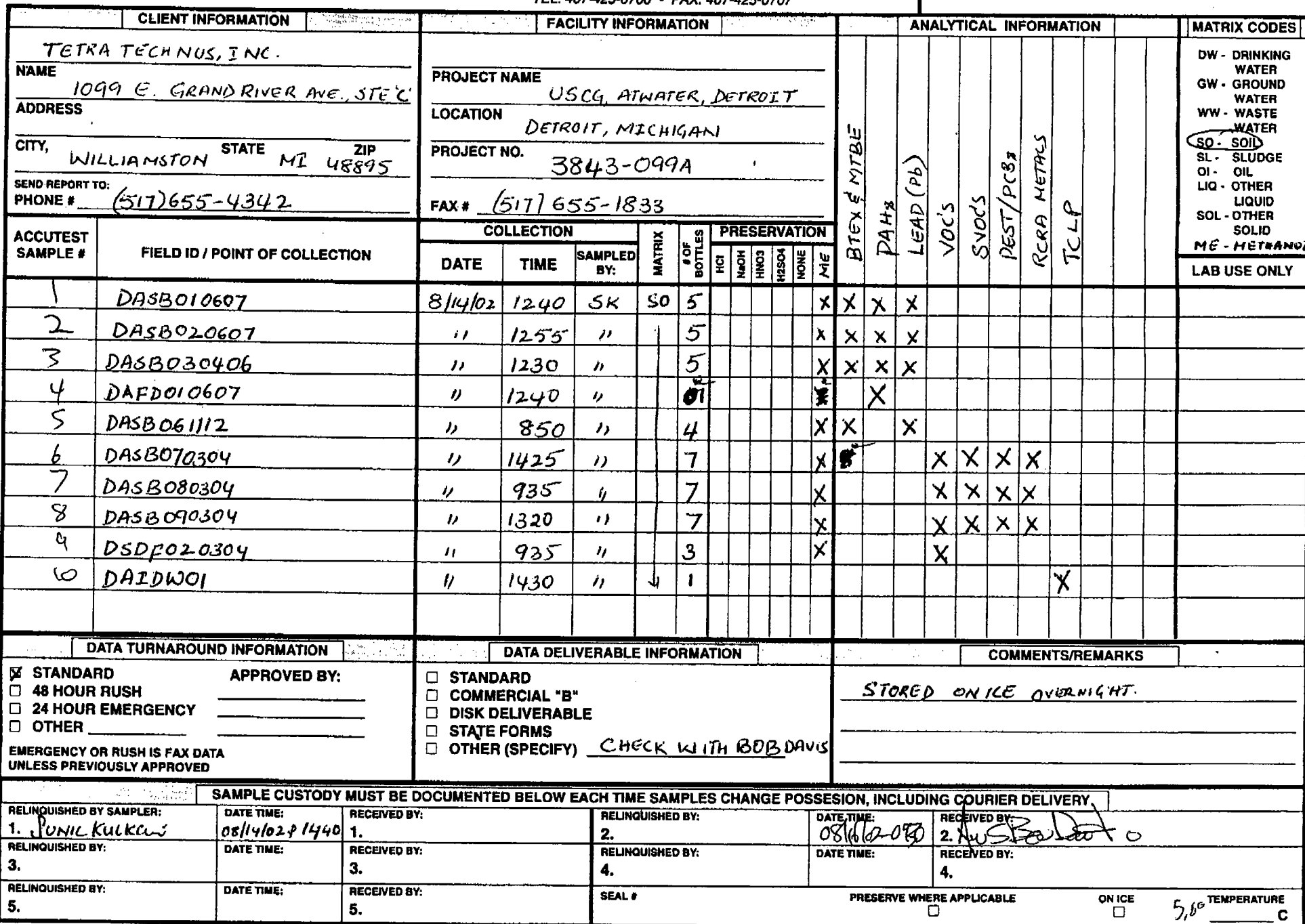
Circle if Applicable:

Signature(s):

MS/MSD	Duplicate ID No.:	
--------	-------------------	--

APPENDIX G.3

CHAIN OF CUSTODY



APPENDIX H

LABORATORY DATA

USCG DETROIT
SUMMARY OF ANALYTIC RESULTS - SOIL
PAGE 1 OF 5

LOCATION	DASB01	DASB01	DASB02	DASB03	DASB06	DASB07	DASB08	DASB08	DASB09
NSAMPLE	DASB010607	DASB010607-D	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DASB080304-D	DASB090304
SAMPLE	DASB010607	DAFD010607	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DSDFO20304	DASB090304
TOP DEPTH	6	6	6	4	11	3	3	3	3
BOTTOM DEPTH	7	7	7	6	12	4	4	4	4
SAMPLE DATE	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02

Volatile Organics (ug/kg)

1,1,1-TRICHLOROETHANE						6.9 U	10 U	410 U	250 U
1,1,2,2-TETRACHLOROETHANE						6.9 U	10 U	410 U	250 U
1,1,2-TRICHLOROETHANE						6.9 U	10 U	410 U	250 U
1,1-DICHLOROETHANE						6.9 U	10 U	410 U	250 U
1,1-DICHLOROETHENE						6.9 U	10 U	410 U	250 U
1,2-DICHLOROBENZENE						6.9 U	10 U	410 U	250 U
1,2-DICHLOROETHANE						6.9 U	10 U	410 U	250 U
1,2-DICHLOROPROPANE						6.9 U	10 U	410 U	250 U
1,3-DICHLOROBENZENE						6.9 U	10 U	410 U	250 U
1,4-DICHLOROBENZENE						6.9 U	10 U	410 U	250 U
2-BUTANONE						34 U	21.1 J	2100 U	1300 U
2-HEXANONE						34 U	52 U	2100 U	1300 U
4-METHYL-2-PENTANONE						34 U	52 U	2100 U	1300 U
ACETONE						45.6 J	92.9 J	4100 U	2500 U
BENZENE	6.3 U		6.9 U	7.1 U	7.8 U	6.9 U	10 U	410 U	250 U
BROMODICHLOROMETHANE						6.9 U	10 U	410 U	250 U
BROMOFORM						6.9 U	10 U	410 U	250 U
BROMOMETHANE						6.9 U	10 U	410 U	250 U
CARBON DISULFIDE						6.9 U	10 U	410 U	250 U
CARBON TETRACHLORIDE						6.9 U	10 U	410 U	250 U
CHLOROBENZENE						6.9 U	10 U	410 U	250 U
CHLORODIBROMOMETHANE						6.9 U	10 U	410 U	250 U
CHLOROETHANE						6.9 U	10 U	410 U	250 U
CHLOROFORM						6.9 U	10 U	410 U	250 U
CHLOROMETHANE						6.9 U	10 U	410 U	250 U
CIS-1,2-DICHLOROETHENE						6.9 U	10 U	410 U	250 U
CIS-1,3-DICHLOROPROPENE						6.9 U	10 U	410 U	250 U
DIETHYL ETHER						34 U	52 U	2100 U	1300 U
ETHYLBENZENE	6.3 U		6.9 U	7.1 U	7.8 U	6.9 U	10 U	410 U	250 U
METHYL TERT-BUTYL ETHER	6.3 U		6.9 U	7.1 U	7.8 U	6.9 U	10 U	410 U	250 U

USCG DETROIT
SUMMARY OF ANALYTIC RESULTS - SOIL
PAGE 2 OF 5

LOCATION	DASB01	DASB01	DASB02	DASB03	DASB06	DASB07	DASB08	DASB08	DASB09
NSAMPLE	DASB010607	DASB010607-D	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DASB080304-D	DASB090304
SAMPLE	DASB010607	DAFD010607	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DSDF020304	DASB090304
TOP DEPTH	6	6	6	4	11	3	3	3	3
BOTTOM DEPTH	7	7	7	6	12	4	4	4	4
SAMPLE DATE	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02
METHYLENE CHLORIDE						14 U	21 U	820 U	500 U
STYRENE						6.9 U	10 U	410 U	250 U
TETRACHLOROETHENE						6.9 U	10 U	410 U	250 U
TOLUENE	6.3 U		6.9 U	7.1 U	7.8 U	6.9 U	10 U	410 U	250 U
TOTAL XYLENES	19 U		21 U	21 U	23 U	21 U	31 U	1200 U	750 U
TRANS-1,2-DICHLOROETHENE						6.9 U	10 U	410 U	250 U
TRANS-1,3-DICHLOROPROPENE						6.9 U	10 U	410 U	250 U
TRICHLOROETHENE						6.9 U	10 U	410 U	250 U
TRICHLOROFLUOROMETHANE						6.9 U	10 U	410 U	250 U
VINYL CHLORIDE						6.9 U	10 U	410 U	250 U

Semivolatile Organics (ug/kg)

1,2,4-TRICHLOROBENZENE						200 U	210 U		200 U
1,2-DICHLOROBENZENE						200 U	210 U		200 U
1,3-DICHLOROBENZENE						200 U	210 U		200 U
1,4-DICHLOROBENZENE						200 U	210 U		200 U
2,2'-OXYBIS(1-CHLOROPROPANE)						200 U	210 U		200 U
2,4,5-TRICHLOROPHENOL						200 U	210 U		200 U
2,4,6-TRICHLOROPHENOL						200 U	210 U		200 U
2,4-DICHLOROPHENOL						200 U	210 U		200 U
2,4-DIMETHYLPHENOL						45.6 J	210 U		200 U
2,4-DINITROPHENOL						980 U	1100 U		980 U
2,4-DINITROTOLUENE						200 U	210 U		200 U
2,6-DINITROTOLUENE						200 U	210 U		200 U
2-CHLORONAPHTHALENE						200 U	210 U		200 U
2-CHLOROPHENOL						200 U	210 U		200 U
2-METHYLNAPHTHALENE	200 U	200 U	210 U	200 U		488	75.6 J		200 U
2-METHYLPHENOL						200 U	210 U		200 U
2-NITROANILINE						390 U	420 U		390 U
2-NITROPHENOL						200 U	210 U		200 U
3&4-METHYLPHENOL						45.2 J	210 U		200 U
3,3'-DICHLOROBENZIDINE						390 U	420 U		390 U

USCG DETROIT
SUMMARY OF ANALYTIC RESULTS - SOIL
PAGE 3 OF 5

LOCATION	DASB01	DASB01	DASB02	DASB03	DASB06	DASB07	DASB08	DASB08	DASB09
NSAMPLE	DASB010607	DASB010607-D	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DASB080304-D	DASB090304
SAMPLE	DASB010607	DAFD010607	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DSD020304	DASB090304
TOP DEPTH	6	6	6	4	11	3	3	3	3
BOTTOM DEPTH	7	7	7	6	12	4	4	4	4
SAMPLE DATE	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02
3-NITROANILINE						390 U	420 U		390 U
4,6-DINITRO-2-METHYLPHENOL						390 U	420 U		390 U
4-BROMOPHENYL PHENYL ETHER						200 U	210 U		200 U
4-CHLORO-3-METHYLPHENOL						200 U	210 U		200 U
4-CHLOROANILINE						390 U	420 U		390 U
4-CHLOROPHENYL PHENYL ETHER						200 U	210 U		200 U
4-NITROANILINE						390 U	420 U		390 U
4-NITROPHENOL						980 U	1100 U		980 U
ACENAPHTHENE	200 U	200 U	42.7 J	200 U		1350	97.2 J		46.6 J
ACENAPHTHYLENE	200 U	200 U	210 U	480		298	73.5 J		69.6 J
ANTHRACENE	200 U	200 U	61.1 J	261		2370	340		166 J
BENZO(A)ANTHRACENE	200 U	45.1 J	149 J	812		4810	807		650
BENZO(A)PYRENE	200 U	50.5 J	128 J	1160		4510	711		594
BENZO(B)FLUORANTHENE	200 U	63.6 J	154 J	865		5030	804		673
BENZO(G,H,I)PERYLENE	200 U	200 U	85.8 J	1180		4080	401		339
BENZO(K)FLUORANTHENE	200 U	200 U	58 J	308		1740	267		209
BIS(2-CHLOROETHOXY)METHANE						200 U	210 U		200 U
BIS(2-CHLOROETHYL)ETHER						200 U	210 U		200 U
BIS(2-ETHYLHEXYL)PHTHALATE						390 U	420 U		390 U
BUTYL BENZYL PHTHALATE						390 U	420 U		390 U
CARBAZOLE						645	90.6 J		54.5 J
CHRYSENE	200 U	46.3 J	146 J	898		4620	753		666
DI-N-BUTYL PHTHALATE						390 U	420 U		390 U
DI-N-OCTYL PHTHALATE						390 U	420 U		390 U
DIBENZO(A,H)ANTHRACENE	200 U	200 U	210 U	233		451	99.7 J		92.5 J
DIBENZOFURAN						647	75.2 J		200 U
DIETHYL PHTHALATE						390 U	420 U		390 U
DIMETHYL PHTHALATE						390 U	420 U		390 U
FLUORANTHENE	200 U	69.8 J	321	875		11100	1940		1370
FLUORENE	200 U	200 U	210 U	200 U		1660	128 J		59 J
HEXACHLOROENZENE						200 U	210 U		200 U

USCG DETROIT
SUMMARY OF ANALYTIC RESULTS - SOIL
PAGE 4 OF 5

LOCATION	DASB01	DASB01	DASB02	DASB03	DASB06	DASB07	DASB08	DASB08	DASB09
NSAMPLE	DASB010607	DASB010607-D	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DASB080304-D	DASB090304
SAMPLE	DASB010607	DAFD010607	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DSDF020304	DASB090304
TOP DEPTH	6	6	6	4	11	3	3	3	3
BOTTOM DEPTH	7	7	7	6	12	4	4	4	4
SAMPLE DATE	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02
HEXACHLOROBUTADIENE						200 U	210 U		200 U
HEXACHLOROCYCLOPENTADIENE						200 U	210 U		200 U
HEXACHLOROETHANE						200 U	210 U		200 U
INDENO(1,2,3-CD)PYRENE	200 U	200 U	210 U	989		3610	474		382
ISOPHORONE						200 U	210 U		200 U
N-NITROSO-DI-N-PROPYLAMINE						200 U	210 U		200 U
N-NITROSODIPHENYLAMINE						200 U	210 U		200 U
NAPHTHALENE	200 U	200 U	210 U	44.2 J		1860	45.1 J		200 U
NITROBENZENE						200 U	210 U		200 U
PENTACHLOROPHENOL						980 U	1100 U		980 U
PHENANTHRENE	200 U	200 U	209 J	356		8430	1220		573
PHENOL						200 U	210 U		200 U
PYRENE	200 U	200 U	287	1360		10800	1150		830
Pesticides/PCBs (ug/kg)									
4,4'-DDD						39 U	210 U		4.0 U
4,4'-DDE						39 U	210 U		4.0 U
4,4'-DDT						39 U	210 U		4.0 U
ALDRIN						19 U	110 U		2.0 U
ALPHA-BHC						19 U	110 U		2.0 U
ALPHA-CHLORDANE						19 U	110 U		2.0 U
AROCLOR-1016						780 U	840 U		800 U
AROCLOR-1221						780 U	840 U		800 U
AROCLOR-1232						780 U	840 U		800 U
AROCLOR-1242						780 U	840 U		800 U
AROCLOR-1248						780 U	840 U		800 U
AROCLOR-1254						780 U	840 U		800 U
AROCLOR-1260						780 U	840 U		800 U
BETA-BHC						19 U	110 U		2.0 U
CHLORDANE (TECHNICAL)						190 U	1100 U		20 U
DELTA-BHC						19 U	110 U		2.0 U
DIELDRIN						19 U	110 U		2.0 U

USCG DETROIT
SUMMARY OF ANALYTIC RESULTS - SOIL
PAGE 5 OF 5

LOCATION	DASB01	DASB01	DASB02	DASB03	DASB06	DASB07	DASB08	DASB08	DASB09
NSAMPLE	DASB010607	DASB010607-D	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DASB080304-D	DASB090304
SAMPLE	DASB010607	DAFD010607	DASB020607	DASB030406	DASB061112	DASB070304	DASB080304	DSDFO20304	DASB090304
TOP DEPTH	6	6	6	4	11	3	3	3	3
BOTTOM DEPTH	7	7	7	6	12	4	4	4	4
SAMPLE DATE	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02	08/14/02
ENDOSULFAN I						19 U	110 U		2.0 U
ENDOSULFAN II						39 U	210 U		4.0 U
ENDOSULFAN SULFATE						39 U	210 U		4.0 U
ENDRIN						39 U	210 U		4.0 U
ENDRIN ALDEHYDE						39 U	210 U		4.0 U
ENDRIN KETONE						39 U	210 U		4.0 U
GAMMA-BHC (LINDANE)						19 U	110 U		2.0 U
GAMMA-CHLORDANE						19 U	110 U		2.0 U
HEPTACHLOR						19 U	110 U		2.0 U
HEPTACHLOR EPOXIDE						19 U	110 U		2.0 U
METHOXYCHLOR						39 U	210 U		4.0 U
TOXAPHENE						1900 U	11000 U		200 U
Inorganics (mg/kg)									
ARSENIC						10.2	13.7	13.2	23.9
BARIUM						459	251	619	122
CADMIUM						0.35	0.32	0.31	0.30
CHROMIUM						7.3	8.7	8.2	10.4
LEAD	9.1		91.1	454	10.7	1070	401	677	338
MERCURY						0.45	0.98	0.35	1.1
SELENIUM						1.8	3.6	8.7	3.8
SILVER						0.07	0.21	0.24	0.20
Miscellaneous Parameters (%)									
PERCENT SOLIDS	83.1	82.3	78.7	80.8	72.9	84.4	78.8	87.3	83.1

USCG DETROIT
SUMMARY OF ANALYTIC RESULT - IDW
PAGE 1 OF 1

LOCATION	IDW
NSAMPLE	DAIDW01
SAMPLE	DAIDW01
SAMPLE DATE	08/14/02

TCLP Volatiles (mg/L)

1,1-DICHLOROETHENE	0.02 U
1,2-DICHLOROETHANE	0.02 U
1,4-DICHLOROBENZENE	0.02 U
2-BUTANONE	0.1 U
BENZENE	0.01 U
CARBON TETRACHLORIDE	0.02 U
CHLOROBENZENE	0.02 U
CHLOROFORM	0.02 U
TETRACHLOROETHENE	0.02 U
TRICHLOROETHENE	0.02 U
VINYL CHLORIDE	0.01 U

TCLP Semivolatiles (mg/L)

1,4-DICHLOROBENZENE	0.05 U
2,4,5-TRICHLOROPHENOL	0.05 U
2,4,6-TRICHLOROPHENOL	0.05 U
2,4-DINITROTOLUENE	0.05 U
2-METHYLPHENOL	0.05 U
3&4-METHYLPHENOL	0.05 U
HEXACHLOROBENZENE	0.05 U
HEXACHLOROBUTADIENE	0.05 U
HEXACHLOROETHANE	0.05 U
NITROBENZENE	0.05 U
PENTACHLOROPHENOL	0.25 U
PYRIDINE	0.05 U

TCLP Pesticides (mg/L)

CHLORDANE (TECHNICAL)	0.005 U
ENDRIN	0.001 U
GAMMA-BHC (LINDANE)	0.0005 U
HEPTACHLOR	0.0005 U
HEPTACHLOR EPOXIDE	0.0005 U
METHOXYCHLOR	0.001 U
TOXAPHENE	0.025 U

TCLP Herbicides (mg/L)

2,4,5-TP (SILVEX)	0.002 U
2,4-D	0.01 U

TCLP Inorganics (mg/L)

ARSENIC	0.01
BARIUM	1.4
CADMIUM	0.0010
CHROMIUM	0.0021
LEAD	0.06
MERCURY	0.00022 U
SELENIUM	0.01
SILVER	0.00055 U

Technical Report for

Tetra Tech, NUS

US Coast Guard Facilities-Northern Michigan

WR# USCG-4 3843-099A

Accutest Job Number: F14241

Report to:

Tetra Tech, NUS


davisb@ttnus.com

ATTN: Bob Davis

Total number of pages in report: 238



Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Conference and/or state specific certification programs as applicable.


Harry Behzadi, Ph.D.
Laboratory Director

Certification: Florida DOH E83510

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Sample Summary

Tetra Tech, NUS

Job No: F14241

US Coast Guard Facilities-Northern Michigan

Project No: WR# USCG-4 3843-099A

Sample Number	Collected Date	Time By	Received	Matrix Code	Type	Client Sample ID
F14241-1	08/14/02	12:40 SK	08/16/02	SO	Soil	DASB010607
F14241-2	08/14/02	12:55 SK	08/16/02	SO	Soil	DASB020607
F14241-3	08/14/02	12:30 SK	08/16/02	SO	Soil	DASB030406
F14241-4	08/14/02	12:40 SK	08/16/02	SO	Soil	DAFD010607
F14241-5	08/14/02	08:50 SK	08/16/02	SO	Soil	DASB061112
F14241-6	08/14/02	14:25 SK	08/16/02	SO	Soil	DASB070304
F14241-7	08/14/02	09:35 SK	08/16/02	SO	Soil	DASB080304
F14241-8	08/14/02	13:20 SK	08/16/02	SO	Soil	DASB090304
F14241-9	08/14/02	09:35 SK	08/16/02	SO	Soil	DSDF020304
F14241-10	08/14/02	14:30 SK	08/16/02	SO	Soil	DAIDW01

Soil samples reported on a dry weight basis unless otherwise indicated on result page.

Report of Analysis

Client Sample ID:	DASB010607	Date Sampled:	08/14/02
Lab Sample ID:	F14241-1	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	83.1
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	K009868.D	1	08/26/02	NAF	n/a	n/a	VK382
Run #2							

Run #	Initial Weight
Run #1	4.74 g
Run #2	

Purgeable Aromatics, MTBE

CAS No.	Compound	Result	RL	Units	Q
71-43-2	Benzene	ND	6.3	ug/kg	
108-88-3	Toluene	ND	6.3	ug/kg	
100-41-4	Ethylbenzene	ND	6.3	ug/kg	
1330-20-7	Xylene (total)	ND	19	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	6.3	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	98%		70-130%
2037-26-5	Toluene-D8	107%		79-121%
460-00-4	4-Bromofluorobenzene	127%		77-133%
17060-07-0	1,2-Dichloroethane-D4	100%		72-133%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB010607		
Lab Sample ID:	F14241-1	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8270C SW846 3550B	Percent Solids:	83.1
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011676.D	1	09/03/02	ME	08/28/02	OP5747	SW633
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.6 g	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	Units	Q
83-32-9	Acenaphthene	ND	200	ug/kg	
208-96-8	Acenaphthylene	ND	200	ug/kg	
120-12-7	Anthracene	ND	200	ug/kg	
56-55-3	Benzo(a)anthracene	ND	200	ug/kg	
50-32-8	Benzo(a)pyrene	ND	200	ug/kg	
205-99-2	Benzo(b)fluoranthene	ND	200	ug/kg	
191-24-2	Benzo(g,h,i)perylene	ND	200	ug/kg	
207-08-9	Benzo(k)fluoranthene	ND	200	ug/kg	
218-01-9	Chrysene	ND	200	ug/kg	
53-70-3	Dibenzo(a,h)anthracene	ND	200	ug/kg	
206-44-0	Fluoranthene	ND	200	ug/kg	
86-73-7	Fluorene	ND	200	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	ND	200	ug/kg	
91-57-6	2-Methylnaphthalene	ND	200	ug/kg	
91-20-3	Naphthalene	ND	200	ug/kg	
85-01-8	Phenanthrene	ND	200	ug/kg	
129-00-0	Pyrene	ND	200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
4165-60-0	Nitrobenzene-d5	92%		41-123%
321-60-8	2-Fluorobiphenyl	95%		46-122%
1718-51-0	Terphenyl-d14	106%		45-135%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB010607	Date Sampled:	08/14/02
Lab Sample ID:	F14241-1	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	83.1
Project:	US Coast Guard Facilities-Northern Michigan		

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Lead	9.1 B	12	0.14	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit
IDL = Instrument Detection Limit

U = Indicates a result < IDL
B = Indicates a result > = IDL but < RL

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB020607	Date Sampled:	08/14/02
Lab Sample ID:	F14241-2	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.7
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	K009869.D	1	08/26/02	NAF	n/a	n/a	VK382
Run #2							

	Initial Weight
Run #1	4.60 g
Run #2	

Purgeable Aromatics, MTBE

CAS No.	Compound	Result	RL	Units	Q
71-43-2	Benzene	ND	6.9	ug/kg	
108-88-3	Toluene	ND	6.9	ug/kg	
100-41-4	Ethylbenzene	ND	6.9	ug/kg	
1330-20-7	Xylene (total)	ND	21	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	6.9	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	99%		70-130%
2037-26-5	Toluene-D8	105%		79-121%
460-00-4	4-Bromofluorobenzene	125%		77-133%
17060-07-0	1,2-Dichloroethane-D4	100%		72-133%

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB020607		Date Sampled:	08/14/02
Lab Sample ID:	F14241-2		Date Received:	08/16/02
Matrix:	SO - Soil		Percent Solids:	78.7
Method:	SW846 8270C SW846 3550B			
Project:	US Coast Guard Facilities-Northern Michigan			

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011677.D	1	09/03/02	ME	08/28/02	OP5747	SW633
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.6 g	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	Units	Q
83-32-9	Acenaphthene	42.7	210	ug/kg	J
208-96-8	Acenaphthylene	ND	210	ug/kg	
120-12-7	Anthracene	61.1	210	ug/kg	J
56-55-3	Benzo(a)anthracene	149	210	ug/kg	J
50-32-8	Benzo(a)pyrene	128	210	ug/kg	J
205-99-2	Benzo(b)fluoranthene	154	210	ug/kg	J
191-24-2	Benzo(g,h,i)perylene	85.8	210	ug/kg	J
207-08-9	Benzo(k)fluoranthene	58.0	210	ug/kg	J
218-01-9	Chrysene	146	210	ug/kg	J
53-70-3	Dibenzo(a,h)anthracene	ND	210	ug/kg	
206-44-0	Fluoranthene	321	210	ug/kg	
86-73-7	Fluorene	ND	210	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	ND	210	ug/kg	
91-57-6	2-Methylnaphthalene	ND	210	ug/kg	
91-20-3	Naphthalene	ND	210	ug/kg	
85-01-8	Phenanthrene	209	210	ug/kg	J
129-00-0	Pyrene	287	210	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
4165-60-0	Nitrobenzene-d5	89%		41-123%
321-60-8	2-Fluorobiphenyl	91%		46-122%
1718-51-0	Terphenyl-d14	99%		45-135%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB020607	Date Sampled:	08/14/02
Lab Sample ID:	F14241-2	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.7
Project:	US Coast Guard Facilities-Northern Michigan		

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Lead	91.1	13	0.16	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit
IDL = Instrument Detection Limit

U = Indicates a result < IDL
B = Indicates a result > = IDL but < RL

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB030406	Date Sampled:	08/14/02
Lab Sample ID:	F14241-3	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	80.8
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	K009870.D	1	08/26/02	NAF	n/a	n/a	VK382
Run #2							

Run #	Initial Weight
Run #1	4.37 g
Run #2	

Purgeable Aromatics, MTBE

CAS No.	Compound	Result	RL	Units	Q
71-43-2	Benzene	ND	7.1	ug/kg	
108-88-3	Toluene	ND	7.1	ug/kg	
100-41-4	Ethylbenzene	ND	7.1	ug/kg	
1330-20-7	Xylene (total)	ND	21	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	7.1	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	97%		70-130%
2037-26-5	Toluene-D8	105%		79-121%
460-00-4	4-Bromofluorobenzene	114%		77-133%
17060-07-0	1,2-Dichloroethane-D4	98%		72-133%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB030406	
Lab Sample ID:	F14241-3	Date Sampled: 08/14/02
Matrix:	SO - Soil	Date Received: 08/16/02
Method:	SW846 8270C SW846 3550B	Percent Solids: 80.8
Project:	US Coast Guard Facilities-Northern Michigan	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011678.D	1	09/03/02	ME	08/28/02	OP5747	SW633
Run #2							

	Initial Weight	Final Volume
Run #1	30.2 g	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	Units	Q
83-32-9	Acenaphthene	ND	200	ug/kg	
208-96-8	Acenaphthylene	480	200	ug/kg	
120-12-7	Anthracene	261	200	ug/kg	
56-55-3	Benzo(a)anthracene	812	200	ug/kg	
50-32-8	Benzo(a)pyrene	1160	200	ug/kg	
205-99-2	Benzo(b)fluoranthene	865	200	ug/kg	
191-24-2	Benzo(g,h,i)perylene	1180	200	ug/kg	
207-08-9	Benzo(k)fluoranthene	308	200	ug/kg	
218-01-9	Chrysene	898	200	ug/kg	
53-70-3	Dibenzo(a,h)anthracene	233	200	ug/kg	
206-44-0	Fluoranthene	875	200	ug/kg	
86-73-7	Fluorene	ND	200	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	989	200	ug/kg	
91-57-6	2-Methylnaphthalene	ND	200	ug/kg	
91-20-3	Naphthalene	44.2	200	ug/kg	J
85-01-8	Phenanthrene	356	200	ug/kg	
129-00-0	Pyrene	1360	200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
4165-60-0	Nitrobenzene-d5	90%		41-123%
321-60-8	2-Fluorobiphenyl	93%		46-122%
1718-51-0	Terphenyl-d14	94%		45-135%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

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Client Sample ID:	DASB030406	Date Sampled:	08/14/02
Lab Sample ID:	F14241-3	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	80.8
Project:	US Coast Guard Facilities-Northern Michigan		

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Lead	454	11	0.14	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit
IDL = Instrument Detection Limit

U = Indicates a result < IDL
B = Indicates a result > = IDL but < RL

Report of Analysis

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Client Sample ID:	DAFD010607	Date Sampled:	08/14/02
Lab Sample ID:	F14241-4	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	82.3
Method:	SW846 8270C SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011679.D	1	09/03/02	ME	08/28/02	OP5747	SW633
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.1 g	1.0 ml
Run #2		

CAS No.	Compound	Result	RL	Units	Q
83-32-9	Acenaphthene	ND	200	ug/kg	
208-96-8	Acenaphthylene	ND	200	ug/kg	
120-12-7	Anthracene	ND	200	ug/kg	
56-55-3	Benzo(a)anthracene	45.1	200	ug/kg	J
50-32-8	Benzo(a)pyrene	50.5	200	ug/kg	J
205-99-2	Benzo(b)fluoranthene	63.6	200	ug/kg	J
191-24-2	Benzo(g,h,i)perylene	ND	200	ug/kg	
207-08-9	Benzo(k)fluoranthene	ND	200	ug/kg	
218-01-9	Chrysene	46.3	200	ug/kg	J
53-70-3	Dibenzo(a,h)anthracene	ND	200	ug/kg	
206-44-0	Fluoranthene	69.8	200	ug/kg	J
86-73-7	Fluorene	ND	200	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	ND	200	ug/kg	
91-57-6	2-Methylnaphthalene	ND	200	ug/kg	
91-20-3	Naphthalene	ND	200	ug/kg	
85-01-8	Phenanthrene	ND	200	ug/kg	
129-00-0	Pyrene	ND	200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
4165-60-0	Nitrobenzene-d5	86%		41-123%
321-60-8	2-Fluorobiphenyl	92%		46-122%
1718-51-0	Terphenyl-d14	94%		45-135%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

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Client Sample ID:	DASB061112	Date Sampled:	08/14/02
Lab Sample ID:	F14241-5	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	72.9
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	K009871.D	1	08/26/02	NAF	n/a	n/a	VK382
Run #2							

Run #	Initial Weight
Run #1	4.42 g
Run #2	

Purgeable Aromatics, MTBE

CAS No.	Compound	Result	RL	Units	Q
71-43-2	Benzene	ND	7.8	ug/kg	
108-88-3	Toluene	ND	7.8	ug/kg	
100-41-4	Ethylbenzene	ND	7.8	ug/kg	
1330-20-7	Xylene (total)	ND	23	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	7.8	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	98%		70-130%
2037-26-5	Toluene-D8	107%		79-121%
460-00-4	4-Bromofluorobenzene	122%		77-133%
17060-07-0	1,2-Dichloroethane-D4	98%		72-133%

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

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Client Sample ID: DASB061112

Lab Sample ID: F14241-5

Matrix: SO - Soil

Date Sampled: 08/14/02

Date Received: 08/16/02

Percent Solids: 72.9

Project: US Coast Guard Facilities-Northern Michigan

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Lead	10.7 B	13	0.16	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit

IDL = Instrument Detection Limit

U = Indicates a result < IDL

B = Indicates a result > = IDL but < RL

Report of Analysis

Client Sample ID:	DASB070304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-6	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	84.4
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	K009895.D	1	08/28/02	NAF	n/a	n/a	VK384
Run #2							

Run #	Initial Weight
Run #1	4.30 g
Run #2	

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
67-64-1	Acetone	45.6	69	ug/kg	J
71-43-2	Benzene	ND	6.9	ug/kg	
75-27-4	Bromodichloromethane	ND	6.9	ug/kg	
75-25-2	Bromoform	ND	6.9	ug/kg	
108-90-7	Chlorobenzene	ND	6.9	ug/kg	
75-00-3	Chloroethane	ND	6.9	ug/kg	
67-66-3	Chloroform	ND	6.9	ug/kg	
75-15-0	Carbon disulfide	ND	6.9	ug/kg	
56-23-5	Carbon tetrachloride	ND	6.9	ug/kg	
75-34-3	1,1-Dichloroethane	ND	6.9	ug/kg	
75-35-4	1,1-Dichloroethylene	ND	6.9	ug/kg	
107-06-2	1,2-Dichloroethane	ND	6.9	ug/kg	
78-87-5	1,2-Dichloropropane	ND	6.9	ug/kg	
124-48-1	Dibromochloromethane	ND	6.9	ug/kg	
156-59-2	cis-1,2-Dichloroethylene	ND	6.9	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	6.9	ug/kg	
541-73-1	m-Dichlorobenzene	ND	6.9	ug/kg	
95-50-1	o-Dichlorobenzene	ND	6.9	ug/kg	
106-46-7	p-Dichlorobenzene	ND	6.9	ug/kg	
156-60-5	trans-1,2-Dichloroethylene	ND	6.9	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	6.9	ug/kg	
100-41-4	Ethylbenzene	ND	6.9	ug/kg	
60-29-7	Ethyl Ether	ND	34	ug/kg	
591-78-6	2-Hexanone	ND	34	ug/kg	
108-10-1	4-Methyl-2-pentanone	ND	34	ug/kg	
74-83-9	Methyl bromide	ND	6.9	ug/kg	
74-87-3	Methyl chloride	ND	6.9	ug/kg	
75-09-2	Methylene chloride	ND	14	ug/kg	
78-93-3	Methyl ethyl ketone	ND	34	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	6.9	ug/kg	
100-42-5	Styrene	ND	6.9	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	6.9	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB070304		
Lab Sample ID:	F14241-6	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8260B	Percent Solids:	84.4
Project:	US Coast Guard Facilities-Northern Michigan		

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
79-34-5	1,1,2,2-Tetrachloroethane	ND	6.9	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	6.9	ug/kg	
127-18-4	Tetrachloroethylene	ND	6.9	ug/kg	
108-88-3	Toluene	ND	6.9	ug/kg	
79-01-6	Trichloroethylene	ND	6.9	ug/kg	
75-69-4	Trichlorofluoromethane	ND	6.9	ug/kg	
75-01-4	Vinyl chloride	ND	6.9	ug/kg	
1330-20-7	Xylene (total)	ND	21	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	93%		70-130%
2037-26-5	Toluene-D8	114%		79-121%
460-00-4	4-Bromofluorobenzene	126%		77-133%
17060-07-0	1,2-Dichloroethane-D4	84%		72-133%

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB070304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-6	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	84.4
Method:	SW846 8270C SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011616.D	1	08/24/02	ME	08/22/02	OP5723	SW630
Run #2	W011632.D	5	08/27/02	ME	08/22/02	OP5723	SW631

Run #	Initial Weight	Final Volume
Run #1	30.1 g	1.0 ml
Run #2	30.1 g	1.0 ml

ABN TCL List

CAS No.	Compound	Result	RL	Units	Q
95-57-8	2-Chlorophenol	ND	200	ug/kg	
59-50-7	4-Chloro-3-methyl phenol	ND	200	ug/kg	
120-83-2	2,4-Dichlorophenol	ND	200	ug/kg	
105-67-9	2,4-Dimethylphenol	45.6	200	ug/kg	J
51-28-5	2,4-Dinitrophenol	ND	980	ug/kg	
534-52-1	4,6-Dinitro-o-cresol	ND	390	ug/kg	
95-48-7	2-Methylphenol	ND	200	ug/kg	
	3&4-Methylphenol	45.2	200	ug/kg	J
88-75-5	2-Nitrophenol	ND	200	ug/kg	
100-02-7	4-Nitrophenol	ND	980	ug/kg	
87-86-5	Pentachlorophenol	ND	980	ug/kg	
108-95-2	Phenol	ND	200	ug/kg	
95-95-4	2,4,5-Trichlorophenol	ND	200	ug/kg	
88-06-2	2,4,6-Trichlorophenol	ND	200	ug/kg	
83-32-9	Acenaphthene	1350	200	ug/kg	
208-96-8	Acenaphthylene	298	200	ug/kg	
120-12-7	Anthracene	2370	200	ug/kg	
56-55-3	Benzo(a)anthracene	4810	200	ug/kg	
50-32-8	Benzo(a)pyrene	4510	200	ug/kg	
205-99-2	Benzo(b)fluoranthene	5030 ^a	980	ug/kg	
191-24-2	Benzo(g,h,i)perylene	4080 ^a	980	ug/kg	
207-08-9	Benzo(k)fluoranthene	1740	200	ug/kg	
101-55-3	4-Bromophenyl phenyl ether	ND	200	ug/kg	
85-68-7	Butyl benzyl phthalate	ND	390	ug/kg	
91-58-7	2-Chloronaphthalene	ND	200	ug/kg	
106-47-8	4-Chloroaniline	ND	390	ug/kg	
86-74-8	Carbazole	645	200	ug/kg	
218-01-9	Chrysene	4620	200	ug/kg	
111-91-1	bis(2-Chloroethoxy)methane	ND	200	ug/kg	
111-44-4	bis(2-Chloroethyl)ether	ND	200	ug/kg	
108-60-1	bis(2-Chloroisopropyl)ether	ND	200	ug/kg	
7005-72-3	4-Chlorophenyl phenyl ether	ND	200	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB070304		
Lab Sample ID:	F14241-6	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8270C SW846 3550B	Percent Solids:	84.4
Project:	US Coast Guard Facilities-Northern Michigan		

ABN TCL List

CAS No.	Compound	Result	RL	Units	Q
95-50-1	1,2-Dichlorobenzene	ND	200	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	200	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	200	ug/kg	
121-14-2	2,4-Dinitrotoluene	ND	200	ug/kg	
606-20-2	2,6-Dinitrotoluene	ND	200	ug/kg	
91-94-1	3,3'-Dichlorobenzidine	ND	390	ug/kg	
53-70-3	Dibenzo(a,h)anthracene	451	200	ug/kg	
132-64-9	Dibenzofuran	647	200	ug/kg	
84-74-2	Di-n-butyl phthalate	ND	390	ug/kg	
117-84-0	Di-n-octyl phthalate	ND	390	ug/kg	
84-66-2	Diethyl phthalate	ND	390	ug/kg	
131-11-3	Dimethyl phthalate	ND	390	ug/kg	
117-81-7	bis(2-Ethylhexyl)phthalate	ND	390	ug/kg	
206-44-0	Fluoranthene	11100 ^a	980	ug/kg	
86-73-7	Fluorene	1660	200	ug/kg	
118-74-1	Hexachlorobenzene	ND	200	ug/kg	
87-68-3	Hexachlorobutadiene	ND	200	ug/kg	
77-47-4	Hexachlorocyclopentadiene	ND	200	ug/kg	
67-72-1	Hexachloroethane	ND	200	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	3610 ^a	980	ug/kg	
78-59-1	Isophorone	ND	200	ug/kg	
91-57-6	2-Methylnaphthalene	488	200	ug/kg	
88-74-4	2-Nitroaniline	ND	390	ug/kg	
99-09-2	3-Nitroaniline	ND	390	ug/kg	
100-01-6	4-Nitroaniline	ND	390	ug/kg	
91-20-3	Naphthalene	1860	200	ug/kg	
98-95-3	Nitrobenzene	ND	200	ug/kg	
621-64-7	N-Nitroso-di-n-propylamine	ND	200	ug/kg	
86-30-6	N-Nitrosodiphenylamine	ND	200	ug/kg	
85-01-8	Phenanthrene	8430 ^a	980	ug/kg	
129-00-0	Pyrene	10800 ^a	980	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
367-12-4	2-Fluorophenol	87%	80%	45-114%
4165-62-2	Phenol-d5	92%	90%	44-124%
118-79-6	2,4,6-Tribromophenol	86%	87%	50-128%
4165-60-0	Nitrobenzene-d5	88%	80%	41-123%
321-60-8	2-Fluorobiphenyl	91%	92%	46-122%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB070304		
Lab Sample ID:	F14241-6	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8270C SW846 3550B	Percent Solids:	84.4
Project:	US Coast Guard Facilities-Northern Michigan		

ABN TCL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1718-51-0	Terphenyl-d14	66%	101%	45-135%

(a) Result is from Run# 2

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB070304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-6	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	84.4
Method:	SW846 8081A SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	DD06918.D	10	08/23/02	SKW	08/20/02	OP5703	GDD260
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.5 g	10.0 ml
Run #2		

Pesticide TCL List

CAS No.	Compound	Result	RL	Units	Q
309-00-2	Aldrin	ND	19	ug/kg	
319-84-6	alpha-BHC	ND	19	ug/kg	
319-85-7	beta-BHC	ND	19	ug/kg	
319-86-8	delta-BHC	ND	19	ug/kg	
58-89-9	gamma-BHC (Lindane)	ND	19	ug/kg	
12789-03-6	Chlordane	ND	190	ug/kg	
5103-71-9	alpha-Chlordane	ND	19	ug/kg	
5103-74-2	gamma-Chlordane	ND	19	ug/kg	
60-57-1	Dieldrin	ND	19	ug/kg	
72-54-8	4,4'-DDD	ND	39	ug/kg	
72-55-9	4,4'-DDE	ND	39	ug/kg	
50-29-3	4,4'-DDT	ND	39	ug/kg	
72-20-8	Endrin	ND	39	ug/kg	
1031-07-8	Endosulfan sulfate	ND	39	ug/kg	
7421-93-4	Endrin aldehyde	ND	39	ug/kg	
53494-70-5	Endrin ketone	ND	39	ug/kg	
959-98-8	Endosulfan-I	ND	19	ug/kg	
33213-65-9	Endosulfan-II	ND	39	ug/kg	
76-44-8	Heptachlor	ND	19	ug/kg	
1024-57-3	Heptachlor epoxide	ND	19	ug/kg	
72-43-5	Methoxychlor	ND	39	ug/kg	
8001-35-2	Toxaphene	ND	1900	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	51%		44-143%
2051-24-3	Decachlorobiphenyl	53%		48-164%

(a) Dilution required due to matrix interference.

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB070304	
Lab Sample ID:	F14241-6	Date Sampled: 08/14/02
Matrix:	SO - Soil	Date Received: 08/16/02
Method:	SW846 8082 SW846 3550B	Percent Solids: 84.4
Project:	US Coast Guard Facilities-Northern Michigan	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	MN15575.D	20	09/04/02	NJ	08/20/02	OP5706	GMN600
Run #2							

	Initial Weight	Final Volume
Run #1	30.5 g	10.0 ml
Run #2		

PCB List

CAS No.	Compound	Result	RL	Units	Q
12674-11-2	Aroclor 1016	ND	780	ug/kg	
11104-28-2	Aroclor 1221	ND	780	ug/kg	
11141-16-5	Aroclor 1232	ND	780	ug/kg	
53469-21-9	Aroclor 1242	ND	780	ug/kg	
12672-29-6	Aroclor 1248	ND	780	ug/kg	
11097-69-1	Aroclor 1254	ND	780	ug/kg	
11096-82-5	Aroclor 1260	ND	780	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	31% ^b		50-134%
2051-24-3	Decachlorobiphenyl	79%		48-147%

(a) Dilution required due to matrix interference.

(b) Outside control limits due to dilution.

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID: DASB070304

Lab Sample ID: F14241-6

Matrix: SO - Soil

Date Sampled: 08/14/02

Date Received: 08/16/02

Percent Solids: 84.4

Project: US Coast Guard Facilities-Northern Michigan

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Arsenic	10.2	0.54	0.31	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Barium	459	22	0.053	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Cadmium	0.35 B	0.43	0.028	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Chromium	7.3	1.1	0.046	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Lead	1070	11	0.13	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Mercury	0.45	0.17	0.010	mg/kg	1	08/21/02	08/28/02 SJL	SW846 7471A	SW846 7471A
Selenium	1.8 B	11	0.21	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Silver	0.066 B	1.1	0.059	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit

IDL = Instrument Detection Limit

U = Indicates a result < IDL

B = Indicates a result > = IDL but < RL

Report of Analysis

Client Sample ID:	DASB080304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-7	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.8
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	K009876.D	1	08/26/02	NAF	n/a	n/a	VK382
Run #2	K009896.D	1	08/28/02	NAF	n/a	n/a	VK384

Run #	Initial Weight
Run #1	3.04 g
Run #2	3.04 g

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
67-64-1	Acetone	92.9	100	ug/kg	J
71-43-2	Benzene	ND	10	ug/kg	
75-27-4	Bromodichloromethane	ND	10	ug/kg	
75-25-2	Bromoform	ND	10	ug/kg	
108-90-7	Chlorobenzene	ND	10	ug/kg	
75-00-3	Chloroethane	ND	10	ug/kg	
67-66-3	Chloroform	ND	10	ug/kg	
75-15-0	Carbon disulfide	ND	10	ug/kg	
56-23-5	Carbon tetrachloride	ND	10	ug/kg	
75-34-3	1,1-Dichloroethane	ND	10	ug/kg	
75-35-4	1,1-Dichloroethylene	ND	10	ug/kg	
107-06-2	1,2-Dichloroethane	ND	10	ug/kg	
78-87-5	1,2-Dichloropropane	ND	10	ug/kg	
124-48-1	Dibromochloromethane	ND	10	ug/kg	
156-59-2	cis-1,2-Dichloroethylene	ND	10	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	10	ug/kg	
541-73-1	m-Dichlorobenzene	ND	10	ug/kg	
95-50-1	o-Dichlorobenzene	ND	10	ug/kg	
106-46-7	p-Dichlorobenzene	ND	10	ug/kg	
156-60-5	trans-1,2-Dichloroethylene	ND	10	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	10	ug/kg	
100-41-4	Ethylbenzene	ND	10	ug/kg	
60-29-7	Ethyl Ether	ND	52	ug/kg	
591-78-6	2-Hexanone	ND	52	ug/kg	
108-10-1	4-Methyl-2-pentanone	ND	52	ug/kg	
74-83-9	Methyl bromide	ND	10	ug/kg	
74-87-3	Methyl chloride	ND	10	ug/kg	
75-09-2	Methylene chloride	ND	21	ug/kg	
78-93-3	Methyl ethyl ketone	21.1	52	ug/kg	J
1634-04-4	Methyl Tert Butyl Ether	ND	10	ug/kg	
100-42-5	Styrene	ND	10	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	10	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB080304		
Lab Sample ID:	F14241-7	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8260B	Percent Solids:	78.8
Project:	US Coast Guard Facilities-Northern Michigan		

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
79-34-5	1,1,2,2-Tetrachloroethane	ND	10	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	10	ug/kg	
127-18-4	Tetrachloroethylene	ND	10	ug/kg	
108-88-3	Toluene	ND	10	ug/kg	
79-01-6	Trichloroethylene	ND	10	ug/kg	
75-69-4	Trichlorofluoromethane	ND	10	ug/kg	
75-01-4	Vinyl chloride	ND	10	ug/kg	
1330-20-7	Xylene (total)	ND	31	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	103%	99%	70-130%
2037-26-5	Toluene-D8	112%	120%	79-121%
460-00-4	4-Bromofluorobenzene	141% ^a	154%	77-133%
17060-07-0	1,2-Dichloroethane-D4	101%	98%	72-133%

(a) Outside control limits due to matrix interference. Confirmed by reanalysis.

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB080304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-7	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.8
Method:	SW846 8270C SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011617.D	1	08/24/02	ME	08/22/02	OP5723	SW630
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.1 g	1.0 ml
Run #2		

ABN TCL List

CAS No.	Compound	Result	RL	Units	Q
95-57-8	2-Chlorophenol	ND	210	ug/kg	
59-50-7	4-Chloro-3-methyl phenol	ND	210	ug/kg	
120-83-2	2,4-Dichlorophenol	ND	210	ug/kg	
105-67-9	2,4-Dimethylphenol	ND	210	ug/kg	
51-28-5	2,4-Dinitrophenol	ND	1100	ug/kg	
534-52-1	4,6-Dinitro-o-cresol	ND	420	ug/kg	
95-48-7	2-Methylphenol	ND	210	ug/kg	
	3&4-Methylphenol	ND	210	ug/kg	
88-75-5	2-Nitrophenol	ND	210	ug/kg	
100-02-7	4-Nitrophenol	ND	1100	ug/kg	
87-86-5	Pentachlorophenol	ND	1100	ug/kg	
108-95-2	Phenol	ND	210	ug/kg	
95-95-4	2,4,5-Trichlorophenol	ND	210	ug/kg	
88-06-2	2,4,6-Trichlorophenol	ND	210	ug/kg	
83-32-9	Acenaphthene	97.2	210	ug/kg	J
208-96-8	Acenaphthylene	73.5	210	ug/kg	J
120-12-7	Anthracene	340	210	ug/kg	
56-55-3	Benzo(a)anthracene	807	210	ug/kg	
50-32-8	Benzo(a)pyrene	711	210	ug/kg	
205-99-2	Benzo(b)fluoranthene	804	210	ug/kg	
191-24-2	Benzo(g,h,i)perylene	401	210	ug/kg	
207-08-9	Benzo(k)fluoranthene	267	210	ug/kg	
101-55-3	4-Bromophenyl phenyl ether	ND	210	ug/kg	
85-68-7	Butyl benzyl phthalate	ND	420	ug/kg	
91-58-7	2-Chloronaphthalene	ND	210	ug/kg	
106-47-8	4-Chloroaniline	ND	420	ug/kg	
86-74-8	Carbazole	90.6	210	ug/kg	J
218-01-9	Chrysene	753	210	ug/kg	
111-91-1	bis(2-Chloroethoxy)methane	ND	210	ug/kg	
111-44-4	bis(2-Chloroethyl)ether	ND	210	ug/kg	
108-60-1	bis(2-Chloroisopropyl)ether	ND	210	ug/kg	
7005-72-3	4-Chlorophenyl phenyl ether	ND	210	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB080304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-7	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.8
Method:	SW846 8270C SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

ABN TCL List

CAS No.	Compound	Result	RL	Units	Q
95-50-1	1,2-Dichlorobenzene	ND	210	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	210	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	210	ug/kg	
121-14-2	2,4-Dinitrotoluene	ND	210	ug/kg	
606-20-2	2,6-Dinitrotoluene	ND	210	ug/kg	
91-94-1	3,3'-Dichlorobenzidine	ND	420	ug/kg	
53-70-3	Dibenzo(a,h)anthracene	99.7	210	ug/kg	J
132-64-9	Dibenzofuran	75.2	210	ug/kg	J
84-74-2	Di-n-butyl phthalate	ND	420	ug/kg	
117-84-0	Di-n-octyl phthalate	ND	420	ug/kg	
84-66-2	Diethyl phthalate	ND	420	ug/kg	
131-11-3	Dimethyl phthalate	ND	420	ug/kg	
117-81-7	bis(2-Ethylhexyl)phthalate	ND	420	ug/kg	
206-44-0	Fluoranthene	1940	210	ug/kg	
86-73-7	Fluorene	128	210	ug/kg	J
118-74-1	Hexachlorobenzene	ND	210	ug/kg	
87-68-3	Hexachlorobutadiene	ND	210	ug/kg	
77-47-4	Hexachlorocyclopentadiene	ND	210	ug/kg	
67-72-1	Hexachloroethane	ND	210	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	474	210	ug/kg	
78-59-1	Isophorone	ND	210	ug/kg	
91-57-6	2-Methylnaphthalene	75.6	210	ug/kg	J
88-74-4	2-Nitroaniline	ND	420	ug/kg	
99-09-2	3-Nitroaniline	ND	420	ug/kg	
100-01-6	4-Nitroaniline	ND	420	ug/kg	
91-20-3	Naphthalene	45.1	210	ug/kg	J
98-95-3	Nitrobenzene	ND	210	ug/kg	
621-64-7	N-Nitroso-di-n-propylamine	ND	210	ug/kg	
86-30-6	N-Nitrosodiphenylamine	ND	210	ug/kg	
85-01-8	Phenanthrene	1220	210	ug/kg	
129-00-0	Pyrene	1150	210	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	210	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
367-12-4	2-Fluorophenol	88%		45-114%
4165-62-2	Phenol-d5	93%		44-124%
118-79-6	2,4,6-Tribromophenol	88%		50-128%
4165-60-0	Nitrobenzene-d5	91%		41-123%
321-60-8	2-Fluorobiphenyl	91%		46-122%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB080304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-7	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.8
Method:	SW846 8270C SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

ABN TCL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1718-51-0	Terphenyl-d14	75%		45-135%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB080304	
Lab Sample ID:	F14241-7	Date Sampled: 08/14/02
Matrix:	SO - Soil	Date Received: 08/16/02
Method:	SW846 8081A SW846 3550B	Percent Solids: 78.8
Project:	US Coast Guard Facilities-Northern Michigan	

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	DD06936.D	50	08/30/02	SKW	08/20/02	OP5703	GDD261
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.2 g	10.0 ml
Run #2		

Pesticide TCL List

CAS No.	Compound	Result	RL	Units	Q
309-00-2	Aldrin	ND	110	ug/kg	
319-84-6	alpha-BHC	ND	110	ug/kg	
319-85-7	beta-BHC	ND	110	ug/kg	
319-86-8	delta-BHC	ND	110	ug/kg	
58-89-9	gamma-BHC (Lindane)	ND	110	ug/kg	
12789-03-6	Chlordane	ND	1100	ug/kg	
5103-71-9	alpha-Chlordane	ND	110	ug/kg	
5103-74-2	gamma-Chlordane	ND	110	ug/kg	
60-57-1	Dieldrin	ND	110	ug/kg	
72-54-8	4,4'-DDD	ND	210	ug/kg	
72-55-9	4,4'-DDE	ND	210	ug/kg	
50-29-3	4,4'-DDT	ND	210	ug/kg	
72-20-8	Endrin	ND	210	ug/kg	
1031-07-8	Endosulfan sulfate	ND	210	ug/kg	
7421-93-4	Endrin aldehyde	ND	210	ug/kg	
53494-70-5	Endrin ketone	ND	210	ug/kg	
959-98-8	Endosulfan-I	ND	110	ug/kg	
33213-65-9	Endosulfan-II	ND	210	ug/kg	
76-44-8	Heptachlor	ND	110	ug/kg	
1024-57-3	Heptachlor epoxide	ND	110	ug/kg	
72-43-5	Methoxychlor	ND	210	ug/kg	
8001-35-2	Toxaphene	ND	11000	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	92%		44-143%
2051-24-3	Decachlorobiphenyl	125%		48-164%

(a) Dilution required due to matrix interference.

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB080304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-7	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.8
Method:	SW846 8082 SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	MN15574.D	20	09/04/02	NJ	08/20/02	OP5706	GMN600
Run #2							

	Initial Weight	Final Volume
Run #1	30.2 g	10.0 ml
Run #2		

PCB List

CAS No.	Compound	Result	RL	Units	Q
12674-11-2	Aroclor 1016	ND	840	ug/kg	
11104-28-2	Aroclor 1221	ND	840	ug/kg	
11141-16-5	Aroclor 1232	ND	840	ug/kg	
53469-21-9	Aroclor 1242	ND	840	ug/kg	
12672-29-6	Aroclor 1248	ND	840	ug/kg	
11097-69-1	Aroclor 1254	ND	840	ug/kg	
11096-82-5	Aroclor 1260	ND	840	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	69%		50-134%
2051-24-3	Decachlorobiphenyl	61%		48-147%

(a) Dilution required due to matrix interference.

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB080304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-7	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	78.8
Project:	US Coast Guard Facilities-Northern Michigan		

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Arsenic	13.7	0.58	0.33	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Barium	251	23	0.057	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Cadmium	0.32 B	0.46	0.030	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Chromium	8.7	1.2	0.050	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Lead	401	12	0.14	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Mercury	0.98	0.21	0.013	mg/kg	1	08/21/02	08/28/02 SJL	SW846 7471A	SW846 7471A
Selenium	3.6 B	12	0.23	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Silver	0.21 B	1.2	0.064	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit
IDL = Instrument Detection Limit

U = Indicates a result < IDL
B = Indicates a result > = IDL but < RL

Report of Analysis

Client Sample ID:	DASB090304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-8	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	83.1
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	K009905.D	1	08/28/02	NAF	n/a	n/a	VK384
Run #2							

	Initial Weight	Final Volume	Methanol Aliquot
Run #1	6.01 g	5.0 ml	100 ul
Run #2			

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
67-64-1	Acetone	ND	2500	ug/kg	
71-43-2	Benzene	ND	250	ug/kg	
75-27-4	Bromodichloromethane	ND	250	ug/kg	
75-25-2	Bromoform	ND	250	ug/kg	
108-90-7	Chlorobenzene	ND	250	ug/kg	
75-00-3	Chloroethane	ND	250	ug/kg	
67-66-3	Chloroform	ND	250	ug/kg	
75-15-0	Carbon disulfide	ND	250	ug/kg	
56-23-5	Carbon tetrachloride	ND	250	ug/kg	
75-34-3	1,1-Dichloroethane	ND	250	ug/kg	
75-35-4	1,1-Dichloroethylene	ND	250	ug/kg	
107-06-2	1,2-Dichloroethane	ND	250	ug/kg	
78-87-5	1,2-Dichloropropane	ND	250	ug/kg	
124-48-1	Dibromochloromethane	ND	250	ug/kg	
156-59-2	cis-1,2-Dichloroethylene	ND	250	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	250	ug/kg	
541-73-1	m-Dichlorobenzene	ND	250	ug/kg	
95-50-1	o-Dichlorobenzene	ND	250	ug/kg	
106-46-7	p-Dichlorobenzene	ND	250	ug/kg	
156-60-5	trans-1,2-Dichloroethylene	ND	250	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	250	ug/kg	
100-41-4	Ethylbenzene	ND	250	ug/kg	
60-29-7	Ethyl Ether	ND	1300	ug/kg	
591-78-6	2-Hexanone	ND	1300	ug/kg	
108-10-1	4-Methyl-2-pentanone	ND	1300	ug/kg	
74-83-9	Methyl bromide	ND	250	ug/kg	
74-87-3	Methyl chloride	ND	250	ug/kg	
75-09-2	Methylene chloride	ND	500	ug/kg	
78-93-3	Methyl ethyl ketone	ND	1300	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	250	ug/kg	
100-42-5	Styrene	ND	250	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	250	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB090304		
Lab Sample ID:	F14241-8	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8260B	Percent Solids:	83.1
Project:	US Coast Guard Facilities-Northern Michigan		

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
79-34-5	1,1,2,2-Tetrachloroethane	ND	250	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	250	ug/kg	
127-18-4	Tetrachloroethylene	ND	250	ug/kg	
108-88-3	Toluene	ND	250	ug/kg	
79-01-6	Trichloroethylene	ND	250	ug/kg	
75-69-4	Trichlorofluoromethane	ND	250	ug/kg	
75-01-4	Vinyl chloride	ND	250	ug/kg	
1330-20-7	Xylene (total)	ND	750	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	93%		70-130%
2037-26-5	Toluene-D8	99%		79-121%
460-00-4	4-Bromofluorobenzene	100%		77-133%
17060-07-0	1,2-Dichloroethane-D4	97%		72-133%

(a) Methanol extract analysis required due to matrix interference (internal standard and surrogate failure).

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB090304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-8	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	83.1
Method:	SW846 8270C SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011618.D	1	08/24/02	ME	08/22/02	OP5723	SW630
Run #2							

Run #	Initial Weight	Final Volume
Run #1	30.7 g	1.0 ml
Run #2		

ABN TCL List

CAS No.	Compound	Result	RL	Units	Q
95-57-8	2-Chlorophenol	ND	200	ug/kg	
59-50-7	4-Chloro-3-methyl phenol	ND	200	ug/kg	
120-83-2	2,4-Dichlorophenol	ND	200	ug/kg	
105-67-9	2,4-Dimethylphenol	ND	200	ug/kg	
51-28-5	2,4-Dinitrophenol	ND	980	ug/kg	
534-52-1	4,6-Dinitro-o-cresol	ND	390	ug/kg	
95-48-7	2-Methylphenol	ND	200	ug/kg	
	3&4-Methylphenol	ND	200	ug/kg	
88-75-5	2-Nitrophenol	ND	200	ug/kg	
100-02-7	4-Nitrophenol	ND	980	ug/kg	
87-86-5	Pentachlorophenol	ND	980	ug/kg	
108-95-2	Phenol	ND	200	ug/kg	
95-95-4	2,4,5-Trichlorophenol	ND	200	ug/kg	
88-06-2	2,4,6-Trichlorophenol	ND	200	ug/kg	
83-32-9	Acenaphthene	46.6	200	ug/kg	J
208-96-8	Acenaphthylene	69.6	200	ug/kg	J
120-12-7	Anthracene	166	200	ug/kg	J
56-55-3	Benzo(a)anthracene	650	200	ug/kg	
50-32-8	Benzo(a)pyrene	594	200	ug/kg	
205-99-2	Benzo(b)fluoranthene	673	200	ug/kg	
191-24-2	Benzo(g,h,i)perylene	339	200	ug/kg	
207-08-9	Benzo(k)fluoranthene	209	200	ug/kg	
101-55-3	4-Bromophenyl phenyl ether	ND	200	ug/kg	
85-68-7	Butyl benzyl phthalate	ND	390	ug/kg	
91-58-7	2-Chloronaphthalene	ND	200	ug/kg	
106-47-8	4-Chloroaniline	ND	390	ug/kg	
86-74-8	Carbazole	54.5	200	ug/kg	J
218-01-9	Chrysene	666	200	ug/kg	
111-91-1	bis(2-Chloroethoxy)methane	ND	200	ug/kg	
111-44-4	bis(2-Chloroethyl)ether	ND	200	ug/kg	
108-60-1	bis(2-Chloroisopropyl)ether	ND	200	ug/kg	
7005-72-3	4-Chlorophenyl phenyl ether	ND	200	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB090304		
Lab Sample ID:	F14241-8	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8270C SW846 3550B	Percent Solids:	83.1
Project:	US Coast Guard Facilities-Northern Michigan		

ABN TCL List

CAS No.	Compound	Result	RL	Units	Q
95-50-1	1,2-Dichlorobenzene	ND	200	ug/kg	
541-73-1	1,3-Dichlorobenzene	ND	200	ug/kg	
106-46-7	1,4-Dichlorobenzene	ND	200	ug/kg	
121-14-2	2,4-Dinitrotoluene	ND	200	ug/kg	
606-20-2	2,6-Dinitrotoluene	ND	200	ug/kg	
91-94-1	3,3'-Dichlorobenzidine	ND	390	ug/kg	
53-70-3	Dibenzo(a,h)anthracene	92.5	200	ug/kg	J
132-64-9	Dibenzofuran	ND	200	ug/kg	
84-74-2	Di-n-butyl phthalate	ND	390	ug/kg	
117-84-0	Di-n-octyl phthalate	ND	390	ug/kg	
84-66-2	Diethyl phthalate	ND	390	ug/kg	
131-11-3	Dimethyl phthalate	ND	390	ug/kg	
117-81-7	bis(2-Ethylhexyl)phthalate	ND	390	ug/kg	
206-44-0	Fluoranthene	1370	200	ug/kg	
86-73-7	Fluorene	59.0	200	ug/kg	J
118-74-1	Hexachlorobenzene	ND	200	ug/kg	
87-68-3	Hexachlorobutadiene	ND	200	ug/kg	
77-47-4	Hexachlorocyclopentadiene	ND	200	ug/kg	
67-72-1	Hexachloroethane	ND	200	ug/kg	
193-39-5	Indeno(1,2,3-cd)pyrene	382	200	ug/kg	
78-59-1	Isophorone	ND	200	ug/kg	
91-57-6	2-Methylnaphthalene	ND	200	ug/kg	
88-74-4	2-Nitroaniline	ND	390	ug/kg	
99-09-2	3-Nitroaniline	ND	390	ug/kg	
100-01-6	4-Nitroaniline	ND	390	ug/kg	
91-20-3	Naphthalene	ND	200	ug/kg	
98-95-3	Nitrobenzene	ND	200	ug/kg	
621-64-7	N-Nitroso-di-n-propylamine	ND	200	ug/kg	
86-30-6	N-Nitrosodiphenylamine	ND	200	ug/kg	
85-01-8	Phenanthrene	573	200	ug/kg	
129-00-0	Pyrene	830	200	ug/kg	
120-82-1	1,2,4-Trichlorobenzene	ND	200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
367-12-4	2-Fluorophenol	91%		45-114%
4165-62-2	Phenol-d5	91%		44-124%
118-79-6	2,4,6-Tribromophenol	89%		50-128%
4165-60-0	Nitrobenzene-d5	96%		41-123%
321-60-8	2-Fluorobiphenyl	97%		46-122%

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB090304		
Lab Sample ID:	F14241-8	Date Sampled:	08/14/02
Matrix:	SO - Soil	Date Received:	08/16/02
Method:	SW846 8270C SW846 3550B	Percent Solids:	83.1
Project:	US Coast Guard Facilities-Northern Michigan		

ABN TCL List

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1718-51-0	Terphenyl-d14	69%		45-135%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DASB090304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-8	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	83.1
Method:	SW846 8081A SW846 3550B		
Project:	US Coast Guard Facilities-Northern Michigan		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	DD06915.D	1	08/23/02	SKW	08/20/02	OP5703	GDD260
Run #2							

	Initial Weight	Final Volume
Run #1	30.1 g	10.0 ml
Run #2		

Pesticide TCL List

CAS No.	Compound	Result	RL	Units	Q
309-00-2	Aldrin	ND	2.0	ug/kg	
319-84-6	alpha-BHC	ND	2.0	ug/kg	
319-85-7	beta-BHC	ND	2.0	ug/kg	
319-86-8	delta-BHC	ND	2.0	ug/kg	
58-89-9	gamma-BHC (Lindane)	ND	2.0	ug/kg	
12789-03-6	Chlordane	ND	20	ug/kg	
5103-71-9	alpha-Chlordane	ND	2.0	ug/kg	
5103-74-2	gamma-Chlordane	ND	2.0	ug/kg	
60-57-1	Dieldrin	ND	2.0	ug/kg	
72-54-8	4,4'-DDD	ND	4.0	ug/kg	
72-55-9	4,4'-DDE	ND	4.0	ug/kg	
50-29-3	4,4'-DDT	ND	4.0	ug/kg	
72-20-8	Endrin	ND	4.0	ug/kg	
1031-07-8	Endosulfan sulfate	ND	4.0	ug/kg	
7421-93-4	Endrin aldehyde	ND	4.0	ug/kg	
53494-70-5	Endrin ketone	ND	4.0	ug/kg	
959-98-8	Endosulfan-I	ND	2.0	ug/kg	
33213-65-9	Endosulfan-II	ND	4.0	ug/kg	
76-44-8	Heptachlor	ND	2.0	ug/kg	
1024-57-3	Heptachlor epoxide	ND	2.0	ug/kg	
72-43-5	Methoxychlor	ND	4.0	ug/kg	
8001-35-2	Toxaphene	ND	200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	91%		44-143%
2051-24-3	Decachlorobiphenyl	88%		48-164%

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DASB090304	
Lab Sample ID:	F14241-8	Date Sampled: 08/14/02
Matrix:	SO - Soil	Date Received: 08/16/02
Method:	SW846 8082 SW846 3550B	Percent Solids: 83.1
Project:	US Coast Guard Facilities-Northern Michigan	

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	MN15573.D	20	09/04/02	NJ	08/20/02	OP5706	GMN600
Run #2							

	Initial Weight	Final Volume
Run #1	30.1 g	10.0 ml
Run #2		

PCB List

CAS No.	Compound	Result	RL	Units	Q
12674-11-2	Aroclor 1016	ND	800	ug/kg	
11104-28-2	Aroclor 1221	ND	800	ug/kg	
11141-16-5	Aroclor 1232	ND	800	ug/kg	
53469-21-9	Aroclor 1242	ND	800	ug/kg	
12672-29-6	Aroclor 1248	ND	800	ug/kg	
11097-69-1	Aroclor 1254	ND	800	ug/kg	
11096-82-5	Aroclor 1260	ND	800	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	105%		50-134%
2051-24-3	Decachlorobiphenyl	129%		48-147%

(a) Dilution required due to matrix interference.

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID: DASB090304

Lab Sample ID: F14241-8

Date Sampled: 08/14/02

Matrix: SO - Soil

Date Received: 08/16/02

Percent Solids: 83.1

Project: US Coast Guard Facilities-Northern Michigan

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Arsenic	23.9	0.53	0.30	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Barium	122	21	0.052	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Cadmium	0.30 B	0.42	0.027	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Chromium	10.4	1.1	0.045	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Lead	338	11	0.13	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Mercury	1.1	0.19	0.012	mg/kg	1	08/21/02	08/28/02 SJL	SW846 7471A	SW846 7471A
Selenium	3.8 B	11	0.21	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Silver	0.20 B	1.1	0.058	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit

IDL = Instrument Detection Limit

U = Indicates a result < IDL

B = Indicates a result > = IDL but < RL

Report of Analysis

Client Sample ID:	DSDFO20304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-9	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	87.3
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1 ^a	K009906.D	1	08/28/02	NAF	n/a	n/a	VK384
Run #2							

Run #	Initial Weight	Final Volume	Methanol Aliquot
Run #1	3.48 g	5.0 ml	100 ul
Run #2			

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
67-64-1	Acetone	ND	4100	ug/kg	
71-43-2	Benzene	ND	410	ug/kg	
75-27-4	Bromodichloromethane	ND	410	ug/kg	
75-25-2	Bromoform	ND	410	ug/kg	
108-90-7	Chlorobenzene	ND	410	ug/kg	
75-00-3	Chloroethane	ND	410	ug/kg	
67-66-3	Chloroform	ND	410	ug/kg	
75-15-0	Carbon disulfide	ND	410	ug/kg	
56-23-5	Carbon tetrachloride	ND	410	ug/kg	
75-34-3	1,1-Dichloroethane	ND	410	ug/kg	
75-35-4	1,1-Dichloroethylene	ND	410	ug/kg	
107-06-2	1,2-Dichloroethane	ND	410	ug/kg	
78-87-5	1,2-Dichloropropane	ND	410	ug/kg	
124-48-1	Dibromochloromethane	ND	410	ug/kg	
156-59-2	cis-1,2-Dichloroethylene	ND	410	ug/kg	
10061-01-5	cis-1,3-Dichloropropene	ND	410	ug/kg	
541-73-1	m-Dichlorobenzene	ND	410	ug/kg	
95-50-1	o-Dichlorobenzene	ND	410	ug/kg	
106-46-7	p-Dichlorobenzene	ND	410	ug/kg	
156-60-5	trans-1,2-Dichloroethylene	ND	410	ug/kg	
10061-02-6	trans-1,3-Dichloropropene	ND	410	ug/kg	
100-41-4	Ethylbenzene	ND	410	ug/kg	
60-29-7	Ethyl Ether	ND	2100	ug/kg	
591-78-6	2-Hexanone	ND	2100	ug/kg	
108-10-1	4-Methyl-2-pentanone	ND	2100	ug/kg	
74-83-9	Methyl bromide	ND	410	ug/kg	
74-87-3	Methyl chloride	ND	410	ug/kg	
75-09-2	Methylene chloride	ND	820	ug/kg	
78-93-3	Methyl ethyl ketone	ND	2100	ug/kg	
1634-04-4	Methyl Tert Butyl Ether	ND	410	ug/kg	
100-42-5	Styrene	ND	410	ug/kg	
71-55-6	1,1,1-Trichloroethane	ND	410	ug/kg	

ND = Not detected

RL = Reporting Limit

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DSDf020304	Date Sampled:	08/14/02
Lab Sample ID:	F14241-9	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	87.3
Method:	SW846 8260B		
Project:	US Coast Guard Facilities-Northern Michigan		

VOA Special List

CAS No.	Compound	Result	RL	Units	Q
79-34-5	1,1,2,2-Tetrachloroethane	ND	410	ug/kg	
79-00-5	1,1,2-Trichloroethane	ND	410	ug/kg	
127-18-4	Tetrachloroethylene	ND	410	ug/kg	
108-88-3	Toluene	ND	410	ug/kg	
79-01-6	Trichloroethylene	ND	410	ug/kg	
75-69-4	Trichlorofluoromethane	ND	410	ug/kg	
75-01-4	Vinyl chloride	ND	410	ug/kg	
1330-20-7	Xylene (total)	ND	1200	ug/kg	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	92%		70-130%
2037-26-5	Toluene-D8	97%		79-121%
460-00-4	4-Bromofluorobenzene	101%		77-133%
17060-07-0	1,2-Dichloroethane-D4	96%		72-133%

(a) Methanol extract analysis required due to matrix interference (internal standard and surrogate failure).

ND = Not detected
 RL = Reporting Limit
 E = Indicates value exceeds calibration range

J = Indicates an estimated value
 B = Indicates analyte found in associated method blank
 N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID: DSDF020304

Lab Sample ID: F14241-9

Matrix: SO - Soil

Date Sampled: 08/14/02

Date Received: 08/16/02

Percent Solids: 87.3

Project: US Coast Guard Facilities-Northern Michigan

Metals Analysis

Analyte	Result	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Method
Arsenic	13.2	0.52	0.30	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Barium	619	21	0.051	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Cadmium	0.31 B	0.42	0.027	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Chromium	8.2	1.0	0.045	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Lead	677	10	0.13	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Mercury	0.35	0.17	0.010	mg/kg	1	08/21/02	08/28/02 SJL	SW846 7471A	SW846 7471A
Selenium	8.7 B	10	0.21	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B
Silver	0.24 B	1.0	0.057	mg/kg	1	08/23/02	08/23/02 DM	SW846 6010B	SW846 3050B

RL = Reporting Limit

IDL = Instrument Detection Limit

U = Indicates a result < IDL

B = Indicates a result > = IDL but < RL

Report of Analysis

Client Sample ID:	DAIDW01	Date Sampled:	08/14/02
Lab Sample ID:	F14241-10	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	n/a
Method:	SW846 8260B SW846 1311		
Project:	US Coast Guard Facilities-Northern Michigan		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	B0011137.D	10	08/23/02	JG	08/21/02	OP5717	VB490
Run #2							

	Purge Volume
Run #1	5.0 ml
Run #2	

VOA TCLP Leachate

CAS No.	Compound	Result	HW#	MCL	RL	Units	Q
71-43-2	Benzene	ND	D018	0.50	0.010	mg/l	
108-90-7	Chlorobenzene	ND	D021	100	0.020	mg/l	
67-66-3	Chloroform	ND	D022	6.0	0.020	mg/l	
56-23-5	Carbon tetrachloride	ND	D019	0.50	0.020	mg/l	
75-35-4	1,1-Dichloroethylene	ND	D029	0.70	0.020	mg/l	
107-06-2	1,2-Dichloroethane	ND	D028	0.50	0.020	mg/l	
106-46-7	p-Dichlorobenzene	ND	D027	7.5	0.020	mg/l	
78-93-3	Methyl ethyl ketone	ND	D035	200	0.10	mg/l	
127-18-4	Tetrachloroethylene	ND	D039	0.70	0.020	mg/l	
79-01-6	Trichloroethylene	ND	D040	0.50	0.020	mg/l	
75-01-4	Vinyl chloride	ND	D043	0.20	0.010	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
1868-53-7	Dibromofluoromethane	101%		86-115%
2037-26-5	Toluene-D8	98%		87-113%
460-00-4	4-Bromofluorobenzene	107%		84-117%
17060-07-0	1,2-Dichloroethane-D4	103%		78-125%

ND = Not detected

MCL = Maximum Contamination Level (40 CFR 261 6/96)

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DAIDW01	Date Sampled:	08/14/02
Lab Sample ID:	F14241-10	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	n/a
Method:	SW846 8270C SW846 3510C		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	W011671.D	1	09/03/02	ME	08/29/02	OP5763	SW633
Run #2							

Run #	Initial Volume	Final Volume
Run #1	100 ml	1.0 ml
Run #2		

ABN TCLP Leachate

CAS No.	Compound	Result	HW#	MCL	RL	Units	Q
95-48-7	2-Methylphenol	ND	D023	200	0.050	mg/l	
	3&4-Methylphenol	ND	D024	200	0.050	mg/l	
87-86-5	Pentachlorophenol	ND	D037	100	0.25	mg/l	
95-95-4	2,4,5-Trichlorophenol	ND	D041	400	0.050	mg/l	
88-06-2	2,4,6-Trichlorophenol	ND	D042	2.0	0.050	mg/l	
106-46-7	1,4-Dichlorobenzene	ND	D027	7.5	0.050	mg/l	
121-14-2	2,4-Dinitrotoluene	ND	D030	0.13	0.050	mg/l	
118-74-1	Hexachlorobenzene	ND	D032	0.13	0.050	mg/l	
87-68-3	Hexachlorobutadiene	ND	D033	0.50	0.050	mg/l	
67-72-1	Hexachloroethane	ND	D034	3.0	0.050	mg/l	
98-95-3	Nitrobenzene	ND	D036	2.0	0.050	mg/l	
110-86-1	Pyridine	ND	D038	5.0	0.050	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
367-12-4	2-Fluorophenol	55%		19-90%
4165-62-2	Phenol-d5	38%		10-68%
118-79-6	2,4,6-Tribromophenol	88%		36-137%
4165-60-0	Nitrobenzene-d5	81%		49-119%
321-60-8	2-Fluorobiphenyl	79%		45-118%
1718-51-0	Terphenyl-d14	94%		46-135%

ND = Not detected

MCL = Maximum Contamination Level (40 CFR 261 6/96)

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Client Sample ID:	DAIDW01	Date Sampled:	08/14/02
Lab Sample ID:	F14241-10	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	n/a
Method:	SW846 8081A SW846 3510C		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	DD06930.D	1	08/30/02	SKW	08/29/02	OP5764	GDD261
Run #2							

Run #	Initial Volume	Final Volume
Run #1	100 ml	10.0 ml
Run #2		

Pesticide TCLP Leachate

CAS No.	Compound	Result	HW#	MCL	RL	Units	Q
58-89-9	gamma-BHC (Lindane)	ND	D013	0.40	0.00050	mg/l	
12789-03-6	Chlordane	ND	D020	0.030	0.0050	mg/l	
72-20-8	Endrin	ND	D012	0.020	0.0010	mg/l	
76-44-8	Heptachlor	ND	D031	0.0080	0.00050	mg/l	
1024-57-3	Heptachlor epoxide	ND	D031	0.0080	0.00050	mg/l	
72-43-5	Methoxychlor	ND	D014	10	0.0010	mg/l	
8001-35-2	Toxaphene	ND	D015	0.50	0.025	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
877-09-8	Tetrachloro-m-xylene	103%		52-131%
2051-24-3	Decachlorobiphenyl	115%		16-153%

ND = Not detected

MCL = Maximum Contamination Level (40 CFR 261.6/96)

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID:	DAIDW01	Date Sampled:	08/14/02
Lab Sample ID:	F14241-10	Date Received:	08/16/02
Matrix:	SO - Soil	Percent Solids:	n/a
Method:	SW846 8151 SW846 3510C		
Project:	US Coast Guard Facilities-Northern Michigan		

Run #	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	GG05982.D	1	09/06/02	ATX	08/31/02	T:OP1293	T:GGG218
Run #2							

Run #	Initial Volume	Final Volume
Run #1	100 ml	10.0 ml
Run #2		

Herbicide TCLP Leachate

CAS No.	Compound	Result	HW#	MCL	RL	Units	Q
94-75-7	2,4-D	ND	D016	10	0.010	mg/l	
93-72-1	2,4,5-TP (Silvex)	ND	D017	1.0	0.0020	mg/l	

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
19719-28-9	2,4-DCAA	97%		10-150%

ND = Not detected

MCL = Maximum Contamination Level (40 CFR 261 6/96)

E = Indicates value exceeds calibration range

J = Indicates an estimated value

B = Indicates analyte found in associated method blank

N = Indicates presumptive evidence of a compound

Report of Analysis

Page 1 of 1

Client Sample ID: DAIDW01	Date Sampled: 08/14/02
Lab Sample ID: F14241-10	Date Received: 08/16/02
Matrix: SO - Soil	Percent Solids: n/a
Project: US Coast Guard Facilities-Northern Michigan	

Metals Analysis, TCLP Leachate SW846 1311

Analyte	Result	HW#	MCL	RL	IDL	Units	DF	Prep	Analyzed By	Method	Prep Met
Arsenic	0.0073 B	D004	5.0	0.010	0.0028	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010
Barium	1.4	D005	100	1.0	0.00049	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010
Cadmium	0.0010 B	D006	1.0	0.0050	0.00026	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010
Chromium	0.0021 B	D007	5.0	0.010	0.00043	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010
Lead	0.062	D008	5.0	0.020	0.0012	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010
Mercury	0.00022 U	D009	0.20	0.010	0.00022	mg/l	1	09/10/02	09/10/02	DM SW846 7470A	SW846 7470
Selenium	0.0071 B	D010	1.0	0.010	0.0020	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010
Silver	0.00055 U	D011	5.0	0.010	0.00055	mg/l	1	09/09/02	09/09/02	DM SW846 6010B	SW846 3010

RL = Reporting Limit IDL = Instrument Detection Limit
MCL = Maximum Contamination Level (40 CFR 261.6(g))

U = Indicates a result < IDL
B = Indicates a result > = IDL but < RL

Appendix F

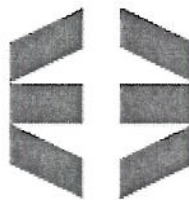
Phase II Environmental Site
Assessment – Enviro Matrix, Inc.

PHASE II ENVIRONMENTAL SITE ASSESSMENT
2660 EAST ATWATER
DETROIT, MI 48207

PREPARED FOR:
ECONOMIC DEVELOPMENT CORPORATION OF THE CITY OF DETROIT
500 GRISWOLD, SUITE 2200
DETROIT, MI 48226
ATTN: MR. WILL TAMMINGA



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JULY 28, 2006

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1.0 EXECUTIVE SUMMARY

Enviro Matrix, Inc. (EM) was retained by the Economic Development Corporation of the City of Detroit (EDC) to perform a Phase II Environmental Site Assessment (ESA) for the property located at 2660 East Atwater, Detroit, MI 48207 (subject property). This assessment followed guidelines set forth in ASTM Method E 1903-97 and was conducted in accordance with the signed proposal between EM and the EDC (Client). The subject property is owned by the U.S. Coast Guard and consists of two (2) boat slips, paved and grassy areas. Two (2) building structures were recently (circa Spring 2005) demolished. The property is located on the northern bank of the Detroit River, northeast of downtown Detroit. It is currently vacant and not utilized for day-to-day operations by the U.S. Coast Guard.

The recent Phase I ESA (April 2006) conducted by EM indicates that the subject property has been used for docking, boat houses, warehouses, as a U.S. Coast Guard station and other possible unknown uses dating back to the late 1800's. In addition, fill of unknown origin may have been brought onto the parcel as the riverfront area has undergone various developments over the last 100-150 years. Past uses, historic heavy industrial activities in the area, and possible fill from unknown location(s) constitute recognized environmental conditions (RECs) for the subject property.

Based on the RECs identified in the Phase I ESA, EM prepared a scope of work to perform subsurface investigations on-site. Upon the contractual agreement between the EDC and EM, fieldwork was initiated on April 25, 2006. Borings were performed to collect subsurface soil samples and groundwater, if observed and accessible. EM utilized the services of McDowell and Associates, of Ferndale, MI to perform soil borings so that EM could ascertain subsurface conditions, conduct a visual inspection and collect representative soil samples for laboratory analysis. Soil borings were placed throughout the property, with special attention to areas where buildings existed in the past. Five (5) soil borings (SB-14 thru SB-18) were performed at the subject property. Six (6) soil samples were submitted for laboratory analysis to verify whether any subsurface contamination exists due to the past land reclamation and industrial use of the parcel and surrounding area.

Analytical data evaluation was performed as part of this subsurface investigation. Applicable Michigan Department of Environmental Quality (DEQ) Residential and Commercial I Part 201 Generic Cleanup Criteria and Screening Levels used for comparison included: Groundwater Surface Water Interface (GSI) Protection Criteria and RBSLs, Soil Volatilization to Indoor Air Inhalation (SVIAI) Criteria and RBSLs, Finite Volatile Soil Inhalation Criteria (VSIC) for 2 Meter Source Thickness, Particulate Soil Inhalation Criteria and RBSLs, and Direct Contact Criteria and RBSLs. Comparisons indicated that some soil samples had concentrations of contaminants at non-detect levels. Some soil samples had detectable concentrations of contaminants below the most restrictive, applicable Part 201 Generic Cleanup Criteria and Screening Levels for Residential and Commercial I Land Use. As per footnote [G] of the Part 201 lookup tables, EM utilized the DEQ provided spreadsheet to determine GSI Criteria for barium, cadmium, chromium, copper, lead, and zinc.

All six (6) soil samples (SB-14 @ 4.0-5.5', SB-14 @ 9.0-10.5', SB-15 @ 1.5-3.0', SB-16 @ 4.0-5.5', SB-17 @ 1.5-3.0' and SB-18 @ 6.5-8.0') showed one or more PNA and / or metal compound above DEQ GSI and / or Direct Contact Criteria. Based on analytical results and the definition of 'facility' as defined by Part 201 of NREPA, this site is considered a 'facility.' Typical mechanisms to address a 'facility' status include:

- Restrictions on land use during (re)development;
- Conduct soil remediation and verification sampling; and / or
- Conduct a Baseline Environmental Assessment (BEA) and provide due care engineering controls to prevent exacerbation of on-site contamination.

The future use of the property is to build a "Riverwalk" at or near surface grade along the riverfront, with possible construction of a building near Atwater.

Due to elevated PNA and metal concentrations (above GSI and / or Direct Contact Criteria) located near the soil surface and further below grade, EM recommends conducting a Baseline Environmental Assessment (BEA) and providing Due Care engineering controls as defined in Section 20107a of Part 201 Environmental Remediation, of the Natural Resources and Environmental Protection Act (NREPA), 1994, PA 451, as amended, during construction and operation to prevent exacerbation of the existing on-site contamination.



2.0 OBJECTIVE AND PURPOSE

The objective of the Phase II Environmental Site Assessment (ESA) was to investigate possible subsurface contamination associated with the historic uses of the subject property, located at 2660 East Atwater, Detroit, Michigan 48207. Based on a Phase I ESA conducted by EM in April 2006, the subject property has been used for docking, boat houses, warehouses, as a U.S. Coast Guard station and other possible unknown uses dating back to the late 1800's. In addition, fill of unknown origin may have been brought onto the parcel as the riverfront underwent various developments over the last 100-150 years. The Phase I ESA revealed the following ASTM recognized environmental conditions (RECs) at the subject property:

- The historic use of the subject property for a variety of industrial uses;
- Historic existence of maintenance garages and use of hazardous substances and petroleum products; and
- The unknown condition of soils related to the past use of adjacent properties for industrial and chemical storage (namely Michigan Limestone and Chemical Co.).

The purpose of the Phase II ESA is to provide the Client, the Economic Development Corporation (EDC), and the City of Detroit with more specific information about environmental conditions at the site. This assessment followed guidelines set forth in ASTM Method E 1903-97 and was conducted in accordance with the signed proposal between EM and the Client.

This Phase II ESA report includes a site location map, map showing the approximate location of soil borings, soil boring logs, soil sampling and laboratory analytical data sheets with chain-of-custody records, chemistry analysis data tables, sample descriptions, discussion and interpretation of results, recommendations and conclusions.

3.0 SITE LOCATION

The subject property is located at 2660 East Atwater, Detroit MI 48207. The property is situated on the northern bank of the Detroit River, and is generally located northeast of downtown Detroit. Approximately half of the property is occupied by two (2) boat slips. The remaining area is concrete / paved with some grass along East Atwater. The grassy areas are locations of former Coast Guard building structures that were recently (circa Spring 2005) demolished. The property is vacant with some scattered debris.

Based on EM's visual and historic research, the property was first developed prior to 1884 and has been utilized for docking, industrial purposes and as a U.S. Coast Guard property. The U.S. Coast Guard currently owns the property, although they are not currently using it for any daily operations. Refer to Figure 1 of Appendix A, for a site location map.

4.0 SAMPLING STRATEGY

Based on the RECs identified in the Phase I ESA (EM, April 2006), EM selected sampling locations for subsurface investigations. Soil boring activities were conducted on April 25, 2006. Approximate soil boring locations are shown in Figure 2 of Appendix A and discussed below. Refer to the following tables located within the text of this report for the following information: Table A: Summary of the Soil



Samples Analyzed (Section 4.0); Table B: Field Observations (Section 6.1); and Table C: Contaminant Concentrations Exceeding Applicable RBSLs (Section 6.4). Sample locations, depths, analytical methods, and laboratory data for samples analyzed are depicted in Tables 1 and 2 of Appendix B. Refer to Section 6.0 for field observations.

GP-14: This location was selected to determine the possible presence of contamination at the southern end of the property, near the Detroit River. Historic aerial and Sanborn Fire Insurance maps indicate that two (2) structures occupied this area at different times in the past, one in 1884 and the other from early to mid 1900's. In addition, this area appears to have been a boat slip (circa 1897 Sanborn map) that was at least partially filled in during the early 1900's. Based on observations during soil borings, two (2) samples were retained for laboratory analysis. The samples were stored in a chilled cooler until delivery to RTI Laboratories, Livonia, MI.

GP-15: This location was selected to determine the possible presence of contamination at the northeast corner of the property. A garage for the U.S. Coast Guard was formerly located at this location. Based on observations during soil borings, one (1) sample was retained for laboratory analysis. The sample was stored in a chilled cooler until delivery to RTI Laboratories, Livonia, MI.

GP-16: This location was selected to determine the possible presence of contamination at the northeast corner of the property. A garage for the U.S. Coast Guard was formerly located at this location. Based on observations during soil borings, one (1) sample was retained for laboratory analysis. The sample was stored in a chilled cooler until delivery to RTI Laboratories, Livonia, MI.

GP-17: This location was selected to determine the possible presence of contamination at the northwest corner of the property. Historic Sanborn Fire Insurance maps indicate that two (2) structures occupied this area at different times in the past, one in the late 1800's to early 1900's and the other from early to mid 1900's. Based on observations during soil borings, one (1) sample was retained for laboratory analysis. The sample was stored in a chilled cooler until delivery to RTI Laboratories, Livonia, MI.

GP-18: This location was selected to determine the possible presence of contamination in the central area of the property. Historic Sanborn Fire Insurance maps indicate that a structure occupied this area in the past (circa 1884) and that this area had been a boat slip (circa 1897 Sanborn map) that was at least partially filled in during the early 1900's. Based on observations during soil borings, one (1) sample was retained for laboratory analysis. The samples were stored in a chilled cooler until delivery to RTI Laboratories, Livonia, MI.

The field observations, site geology, hydrology and soil chemistry are discussed in Section 6.0 of this report. A data table (Table 1) presenting soil analytical results are presented in Appendix B. Soil boring logs are included in Appendix C. The laboratory analytical data reports, including the chemical analytical methods, regulatory derived target detection limits, and chain of custody (C.O.C.) are included in Appendix D. Sampling locations, estimated sampling depth, sample matrix, constituents of concern and analyses methods are summarized below in Table A:

Table A: Summary of the Soil Samples Analyzed

Sampling Location	Depth (feet)	Matrix	Compounds Analyzed	EPA Analyses Method No.(s)
SB-14	4.0-5.5	Soil	PNAs, Metals (Michigan 10)	8270C, 6020A, 7471A
	9.0-10.5	Soil	PNAs, Metals (Michigan 10)	8270C, 6020A, 7471A
SB-15	1.5-3.0	Soil	VOCs, PNAs, Metals (Michigan 10)	8260B, 8270C, 6020A, 7471A
SB-16	4.0-5.5	Soil	PNAs, Metals (Michigan 10)	8270C, 6020A, 7471A
SB-17	1.5-3.0	Soil	PNAs, Metals (Michigan 10)	8270C, 6020A, 7471A
SB-18	6.5-8.0	Soil	PNAs, Metals (Michigan 10)	8270C, 6020A, 7471A

Michigan 10 includes: arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, zinc.

5.0 PROCEDURES FOR SAMPLE COLLECTION

Procedures for sample collection, sample preservation, sample handling, sample custody, field equipment operation, decontamination, and preventive maintenance followed EPA's Standard Operating Procedures and Quality Assurance Manual (1997r) guidance and the Enviro Matrix, Inc. Standard Operating Procedures.

Field equipment was either new or decontaminated and cleaned prior to each use. Sampling jars were new. Field investigators wore a new pair of disposable, nitrile gloves when collecting each sample to prevent cross-contamination of the samples and to reduce exposure to hazardous substances. Samples requiring preservation were field preserved immediately after collection of the sample.

5.1 Soil

Soil borings were installed using a truck-mounted, rotary auger with split-spoon sampler, supplied and operated by McDowell and Associates, Ferndale, MI. The sampling device used to collect the soil samples during this investigation was a 2" outside diameter (OD), 1-foot length "split-spoon" sampler. The sampler is a hollow tube consisting of two halves split lengthwise; held together by circular connector. When the split-spoon sampler was driven into the subsurface by a drive weight, soil collected in the tube, and was then retrieved to the surface. The connector was removed to allow one half of the tubing to be detached, providing access the soil. Multiple split-spoon samplers were utilized to prevent cross-contamination. Refer to Appendix A, Figure 2 for a Soil Boring Location Map and Appendix C for Soil Boring Logs.

The soil lithology was visually inspected and characterized. Soil type, color and characteristics were noted. Based on field screening and observations, six (6) soil samples were retained by the on-site geologist for chemical analysis by an independent laboratory.

Soil samples were placed into pre-labeled, laboratory-supplied sampling containers. Labels on the sample jars indicated the site name, sample number identifying the location of the soil sample, the date and time the sample was collected, and the name of the individual collecting the soil sample. The soil was packed tightly into the container to eliminate headspace and to minimize volatilization of potential contaminants in the samples. Glass sample jars (4-oz.) with Teflon-lined screw lids were used for collecting soil samples. Soil samples to be analyzed for VOCs were methanol preserved in 40 mL vials in the field per EPA SW-846 Method 5035. The samples were packed in a chilled cooler and kept cool until delivered to RTI Laboratories.

Livonia, MI for analysis. Refer to Table A: Summary of the Soil Samples Analyzed in Section 4.0 and Section 5.3 of this report for details regarding individual analyses.

5.2 Groundwater

Groundwater samples were not collected from the site. Soil was moist to wet at some locations; however, field conditions did not produce large enough quantities to collect adequate water samples. For additional details pertaining to site specific hydrology, refer to Section 6.3, Hydrology.

5.3 Laboratory Analysis

The samples were analyzed for the presence of selective indicator compounds based on known historical use of the property and suspected contamination. Soil samples were selectively analyzed for the presence of VOCs, PNAs and Michigan metals [arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, zinc] using EPA SW-846 Test Method; EPA 8260B for VOCs, EPA 8270C for PNAs, EPA 6020A for metals (except mercury) and EPA 7471A for mercury, as per the Michigan Department of Environmental Quality (DEQ) Operational Memorandum No. 2 (October 22, 2004). The laboratory analytical reports are compiled in Attachment D of this report. Refer to Appendix B, Tables 1 and 2 for a comparison of laboratory analysis data to DEQ cleanup criteria.

6.0 EVALUATION OF FIELD CONDITIONS AND ANALYTICAL RESULTS

6.1 Field Observations

A total of five (5) soil borings were placed at the site during the Phase II subsurface investigation. The following table depicts field observations along with the sample identification, location, depths, and soil description at the time of each sample collection during the subsurface investigation.

Table B: Field Observations

<u>Soil Boring</u>	<u>Boring Location*</u>	<u>Depth of Boring (feet)</u>	<u>Soil Sample Depth(s) (feet)</u>	<u>Soil Notes**</u>	<u>Soil Sample(s) Analyzed</u>	<u>GW*** Observed / Depth (feet)</u>
SB-14	55' north of the eastern slip and 45' east of the western slip	25.5	4.0-5.5 9.0-10.5	Stained and non-stained fill; no odor	Yes Yes	Yes / 22.0
SB-15	15' south of E. Atwater and 15' east of the eastern property line (location of former garage)	15.5	1.5-3.0	Stained and non-stained fill; no odor	Yes	Yes / 12.5
SB-16	50' south of E. Atwater and 10' east of the eastern property line (location of former garage)	15.5	4.0-5.5	Stained and non-stained fill; no odor	Yes	Yes / 3.5

SB-17	30' south of E. Atwater and 25' west of the western property line (location of former office)	15.5	1.5-3.0	Stained and non-stained fill; no odor	Yes	Yes / 8.75
SB-18	95' south of E. Atwater and 25' east of the western slip	20.5	6.5-8.0	Stained and non-stained fill; no odor	Yes	Yes / 3.25 and 12.5

* Refer to Figure 2: Soil Boring Location Map in Appendix A for locations of soil borings.

** Refer to Soil Boring Logs in Appendix C and Section 6.2 below for additional subsurface details.

*** GW: Groundwater; does not indicate whether a true aquifer is present, only if soils were wet.

6.2 Site Specific Geology

Areas of the property not occupied by water are covered with asphalt and concrete paving or grass / weeds followed by topsoil. Dark brown topsoil extended to approximately 0.5'-1.5' below surface grade (bsg). Below the topsoil or paving was fill. Fill consisted of either silty fine to medium sand with clay layers, silty clay with occasional sand layers, or variegated clay layers and extended to approximately 4.0'-17.5' bsg. Discoloration was observed throughout the fill. Below the fill was clayey fine to medium sand, sandy silty clay, or sandy clay was encountered through the end of the borings (ranging from 15.5' to 25.5' bsg). Occasional sand seams and organic sand layers were also noted. Refer to Figure 2 in Appendix A for details on soil boring location for each boring. The soil boring logs depicting soil lithology are included in Appendix C.

6.3 Hydrology

Moist soils were encountered in each boring at depths ranging from approximately 3.5' to 22.0' bsg. Encountering some moist soils was expected due to close proximity of the site to the Detroit River, and the presence of fill material throughout the site. The volume and condition of the groundwater within this zone was insufficient to assess the hydrological features (flow direction and yield). It is EM's opinion that the groundwater observed between approximately 3.5' and 22.0' bsg is perched water and not associated with any groundwater aquifer capable of producing water for potable or non-potable use. Based on field observations and groundwater conditions, water samples were not collected.

6.4 Analytical Results

The field and laboratory data collected during this Phase II investigation were evaluated to determine whether contaminant concentrations exist above the established DEQ Residential and Commercial Cleanup Criteria at the subject property. Soil analytical data is assembled in a table format (refer to Tables 1 and 2 in Appendix B) for comparison with the applicable Part 201 Generic Cleanup Criteria and Risk Based Screening Levels (RBSLs) for Residential and Commercial I Land Use provided under Part 201, P.A. 451 of 1994, as amended. The analytical data for the soil samples indicates soils at the subject property have been impacted by PNAs and metals.

Reported concentrations for at least one (1) compound were reported above the most restrictive cleanup criteria for all six (6) soil samples: SB-14 @ 4.0-5.5', SB-14 @ 9.0-10.5', SB-15 @ 1.5-3.0', SB-16 @ 4.0-5.5', SB-17 @ 1.5-3.0' and SB-18 @ 6.5-8.0'.

The laboratory chemical data reports, including the chemical analytical methods and chain of custody, are attached as Appendix D. Table C below presents contaminant concentrations detected above the applicable cleanup criteria, specifically GSI and Direct Contact, in soil samples collected from the site.

Table C: Contaminant Concentrations Exceeding Applicable RBSLs

<u>Contaminant</u>	<u>Concentration (ug/kg) / Criteria* (ug/kg)</u>	<u>Sample ID and Depth (feet)</u>
Soil – PNAs		
Benzo(a)pyrene	2,400 / 2,000 ²	SB-14 @ 4.0-5.5
Fluoranthene	9,200 / 5,500 ¹	
Phenanthrene	14,000 / 5,300 ¹	
Benzo(a)pyrene	2,700 / 2,000 ²	SB-17 @ 1.5-3.0
Fluoranthene	7,700 / 5,500 ¹	
Phenanthrene	7,500 / 5,300 ¹	
Benzo(a)pyrene	5,500 / 2,000 ²	SB-18 @ 6.5-8.0
Fluoranthene	17,000 / 5,500 ¹	
Phenanthrene	5,500 / 5,300 ¹	
Soil – Metals		
Arsenic	11,000 / 7,600 ²	SB-14 @ 4.0-5.5
Lead	510,000 / 400,000 ²	
Mercury	280 / 50 ¹	
Selenium	630 / 400 ¹	
Silver	300 / 100 ¹	
Arsenic	7,800 / 7,600 ²	SB-14 @ 9.0-10.5
Mercury	140 / 50 ¹	
Silver	170 / 100 ¹	
Mercury	170 / 50 ¹	SB-15 @ 1.5-3.0
Selenium	850 / 400 ¹	
Mercury	1,100 / 50 ¹	SB-16 @ 4.0-5.5
Selenium	420 / 400 ¹	
Silver	140 / 100 ¹	
Arsenic	8,400 / 7,600 ²	SB-17 @ 1.5-3.0
Mercury	210 / 50 ¹	
Selenium	640 / 400 ¹	
Silver	130 / 100 ¹	
Mercury	730 / 50 ¹	SB-18 @ 6.5-8.0
Selenium	880 / 400 ¹	
Silver	160 / 100 ¹	

* Residential and Commercial I Cleanup Criteria exceeded are as follows:

¹ Groundwater Surface Water Interface (GSI) Protection Criteria and RBSLs

² Direct Contact Criteria and RBSLs

No VOCs were reported above the most restrictive DEQ criteria for any of the samples analyzed. Three (3) PNAs (benzo(a)pyrene, fluoranthene and phenanthrene) were reported above GSI or Direct Contact Criteria for SB-14 @ 4.0-5.5', SB-17 @ 1.5-3.0', and SB-18 @ 6.5-8.0'. One or more metal (arsenic, lead, mercury, selenium and silver) was reported above GSI or Direct Contact Criteria for all six (6) soil samples.

7.0 SELECTION OF CLEANUP CRITERIA

Soil analytical data collected from the site was assembled in a table and compared with the Residential and Commercial I Cleanup standards provided under Part 201, P.A. 451 of 1994, as amended. Refer to Table 1 and Table 2 found in Appendix B of this report for a summary of the laboratory analytical data compared to applicable DEQ cleanup criteria. Since moist soils were observed at this site, the groundwater related exposure pathways, such as drinking water and groundwater contact criteria may be applicable as outlined in RRD Operational Memorandum No. 1, Part 201 Cleanup Criteria, revised on December 10, 2004. In addition, based on the close proximity of the Detroit River to the subject property (the Detroit River borders the subject property), Groundwater Surface Water Interface (GSI) Criteria may also apply for this site.

Municipal water supply is the source of potable water in Detroit, MI. The Detroit Water and Sewerage Department (DWSD) "draws fresh water from the Great Lakes System, with Lake Huron to the north and the Detroit River to the south."¹ All water passes through sophisticated water treatment system, including chemical testing, before use as potable drinking water. These conditions suggest that the health-based or aesthetic drinking water cleanup criteria are not applicable to the subject property. No groundwater aquifer was encountered, therefore groundwater contact criteria is not applicable to the subject property. Presence of a surface water body immediately bordering the subject property and moist to wet soils observed on-site indicates that the GSI criterion is applicable to the subject property. Refer to Guidesheet 12: Generic Soil Criteria Protective of the Groundwater Surface Water Interface (GSI), found in the DEQ document entitled "Training Material – Part 201 Cleanup Criteria & Part 213 Risk-Based Screening Levels," dated June 2006, for additional information pertaining to applicability of the GSI criterion.

Due to the presence of possible contaminants in soils at shallow depth and a possibility of future excavation and / or construction at the property, the volatilization of contaminants from soil are relevant pathways. Possibility of direct contact with impacted soil is another exposure pathway relevant to the subject property. Construction / utility workers and others could be exposed to contaminated soil or particulates during any future excavation / construction and use of subsurface structure in the impacted area. Accordingly, air inhalation of vapors from impacted soil, particulate soil inhalation and direct contact are selected as relevant exposure risks associated with soil at the site.

Given that air inhalation and direct contact are exposure and migration pathways for potential receptors in reference to impacted soil at the site, protection for air and direct contact exposure are necessary. Thus, for each indicator compound, the most restrictive of Groundwater Surface Water Interface (GSI) Protection Criteria and RBSLs, Soil Volatilization to Indoor Air Inhalation (SVIAI) Criteria and RBSLs, Finite Volatile Soil Inhalation Criteria (VSIC) for 2 Meter Source Thickness, Particulate Soil Inhalation Criteria and RBSLs, and Direct Contact Criteria and RBSLs for Residential and Commercial I Land Use

¹ Source: DWSD "Fact Sheet" found at <http://www.dwsd.org/about/index.html>

were selected as applicable DEQ cleanup criteria for the subject property. The soil cleanup criteria established under the Part 201 of the Natural Resources and Environmental Protection Act, 1994 P.A. 451, as amended, were utilized for determining the contamination at the site.

8.0 CONCLUSIONS AND RECOMMENDATIONS

This Phase II ESA investigated the Recognized Environmental Conditions (RECs) identified in the Phase I ESA conducted in April, 2006. Analytical data evaluation performed as part of this subsurface investigation indicated that some soil samples had concentrations of contaminants at non-detect levels. Some soil samples had detectable concentrations of contaminants below the Part 201 Generic Cleanup Criteria via exposure for Residential and Commercial I Land Use. As per footnote [G] of the Part 201 lookup tables, EM utilized the DEQ provided spreadsheet ["Calculation of Generic Facility-Specific Part 201 Soil GSI Protection Criteria," (GSI PC) of P.A. 451 of 1994, as amended] to determine GSI Criteria for barium, cadmium, chromium, copper, lead, and zinc. The calculated numbers were used as the GSI Criteria comparison in Tables 1 and 2 found in Appendix B of this report. Refer to Appendix B for the DEQ spreadsheet used in GSI calculation.

Due to the sample matrix and interference with non-targeted compounds during laboratory analysis, the detection limit for three (3) VOC compounds was reported above DEQ GSI Criteria. VOCs are not likely a concern for the subject property based on field conditions and analytical results for other VOC compounds. In addition, based on analytical results for PNAs and metal compounds for all samples, the property is determined to be a facility; therefore additional VOC analysis was not conducted as a cost savings measure.

Evidence of elevated PNA and metal concentrations in soils throughout the property warrants further attention for BEA and due care purposes. PNAs and metals can enter the environment by during land reclamation activities (i.e., placement of fill) or by fugitive air emissions from various industrial activities and facilities. PNAs released to the soil are subject to evaporation into the atmosphere, and under certain conditions sunlight and air can increase volatilization of PNAs near the soil surface. Metals near the soil surface will remain mostly sedimentary unless disturbed by human activities such as excavation, removal, etc.

The vicinity of PNA and metal concentrations in soils at the subject property reveals that the past use of the property and the general area for land reclamation and as industrial related establishments may have contributed to the surface soil contamination of the subject property. Further, subsurface soil contamination may be a result of past on-site activities or contamination of fill prior to being placed on-site. Based on the analytical results of soil samples collected from the site, EM concludes that the site is a 'facility' as defined under provision of Part 201 of P.A. 451 of 1994, as amended.

All six (6) soil samples (SB-14 @ 4.0-5.5', SB-14 @ 9.0-10.5', SB-15 @ 1.5-3.0', SB-16 @ 4.0-5.5', SB-17 @ 1.5-3.0', SB-18 @ 6.5-8.0') showed one or more PNA and / or metal compound above DEQ GSI and / or Direct Contact Criteria. Based on analytical results and the definition of 'facility' as defined by Part 201 of NREPA, this site is considered a 'facility.' Typical mechanisms to address a 'facility' status include:

- Restrictions on land use during (re)development;
- Conduct soil remediation and verification sampling; and / or

- Conduct a Baseline Environmental Assessment (BEA) and provide due care engineering controls to prevent exacerbation of on-site contamination.

The near term future use of the property is to build a "Riverwalk" at or near surface grade along the riverfront, with possible construction of a building near Atwater.

Due to elevated PNA and metal concentrations (above GSI and / or Direct Contact Criteria) located near the soil surface and further below grade, EM recommends conducting a Baseline Environmental Assessment (BEA) and providing Due Care engineering controls as defined in Section 20107a of Part 201 Environmental Remediation, of the Natural Resources and Environmental Protection Act (NREPA), 1994, PA 451, as amended, during construction and operation to prevent exacerbation of on-site contamination.

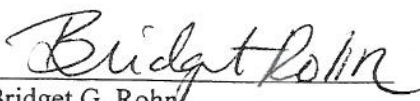
9.0 LIMITATIONS

This report has been prepared in accordance with standard industry practice for a Phase II Environmental Site Assessment (ESA) using a rotary auger with a split-spoon sampler to obtain soil samples. The information presented is based in part on the laboratory analytical results of the soil samples collected by EM during the Phase II ESA at the subject property, field conditions at the time of the Phase II ESA, and background / historical knowledge of the site. All information was intended only to determine if contamination exists in the prescribed location, and to determine whether this property is a "facility." Soil conditions between and beyond the sampling locations and the areas not investigated may be different than the conditions indicated by the analytical results at the sampling locations.

The information and conclusions presented in this report reflect EM's best judgment and should be implemented only in light of the information available to EM at the time of preparation, and are for use exclusively by the Economic Development Corporation (EDC), the City of Detroit and U.S. Coast Guard. Any use which a third party (other than EDC) makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. EM accepts no responsibility for damages, if any, suffered by any third party, because of decisions made or actions based on this report. EM will not distribute or publish this report lacking consent from EDC, unless required by law or court order. This document provides a reasonable environmental assessment of the conditions at the subject property as of May, 2006 and makes conclusions and recommendations based on these findings.

10.0 SIGNATORIES

Preparer represents that to the best of preparer's knowledge the above statements and facts are true and correct and to the best of preparer's actual knowledge no material facts have been suppressed or misstated.


Bridget G. Rohn
Environmental Scientist



Kirit T. Ravani, P.E., CHMM, CP
Principal

TABLE 1: SOIL ANALYTICAL DATA - VOC

VOLATILES	Part 201 Generic Cleanup Criteria Residential & Commercial I						
Sample ID	Groundwater	Indoor Air	Ambient Air Protection		Direct Contact Criteria & RBSLs	15	
Sample Depth (feet BSG)	Groundwater	Soil	Finite VSIC* for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs		1.5-3.0	
Date Collected	Surface Water	Volatilization to Indoor Air				4/25/2006	
Date Analyzed	Interface	Inhalation				4/28/2006	
Analytical Method No.	Protection	Criteria &				SW 8260B	
Collection Method	Criteria &	RBSLs				GRAB	
CONSTITUENT (µg/kg)	RBSLs	RBSLs				Conc	MDL
Acetone (I)	34,000	1.1E+8 (C)	1.9E+08	3.9E+11	2.3E+7	150	2,800
Acrylonitrile (I)	100 (M,X); 98	6,600	10,000	4.6E+7	16,000	<280	280
Benzene (I)	240 (X)	1,600	79,000	3.8E+8	180,000	<57	57
Bromobenzene (I)	NA	310,000	450,000	5.3E+8	540,000	<57	57
Bromodichloromethane	ID	1,200	19,000	8.4E+7	110,000	<57	57
Bromoform	ID	150,000	900,000	2.8E+9	820,000	<57	57
Bromomethane	700	860	140,000	3.3E+8	320,000	<280	280
t-Butyl alcohol	NA	1.1E+8 (C)	2.0E+8	1.30E+11	1.1E+8 (C)	<2,300	2,300
n-Butylbenzene	26,000 (X)	NLV	NLV	4.70E+10	3.1E+5 (C)	<57	57
sec-Butylbenzene	ID	ID	ID	ID	2.5E+6	<57	57
t-Butylbenzene (I)	NA	ID	ID	ID	2.5E+6	<57	57
2-Chloroethyl vinyl ether	NA	ID	ID	ID	ID	<570	570
Carbon disulfide (I,R)	ID	76,000	1.9E+07	4.7E+10	280,000 (C,DD)	<280	280
Carbon tetrachloride	110 (X)	190	28,000	1.3E+8	96,000	<57	57
Chlorobenzene (I)	940	120,000	2.1E+06	4.7E+9	260,000 (C)	<57	57
Chloroethane	ID	950,000 (C)	2.8E+08	6.7E+11	950,000 (C)	<280	280
Chloroform	1,500 (X)	7,200	270,000	1.3E+9	1.2E+6	<57	57
Chloromethane (I)	ID	2,300	1.0E+06	4.9E+9	1.1E+6 (C)	<57	57
cis-1,2-Dichloroethylene	12,000	22,000	9.9E+5	2.3E+9	6.4E+5 (C)	<57	57
trans-1,2-Dichloroethylene	30,000	23,000	2.0E+6	4.7E+9	1.4E+6 (C)	<57	57
1,1-Dichloroethane	15,000	2.3E+5	1.4E+7	3.3E+10	8.9E+5 (C)	<57	57
1,1-Dichloroethene	1,300 (X)	62	1.3E+04	6.2E+7	2.0E+5	<57	57
1,2-Dichlorobenzene	360	210,000 (C)	5.2E+07	1.0E+11	210,000 (C)	<57	57
1,2-Dichloroethane	120 (X)	2,100	26,000	1.2E+8	91,000	<57	57
1,3-Dichlorobenzene	1,100	ID	ID	ID	170,000 (C)	<57	57
1,2-Dichloropropane (I)	5,800 (X)	4,000	110,000	2.7E+8	1.4E+5	<57	57
Dibromochloromethane	ID	3,900	33,000	1.3E+8	110,000	<57	57
Dibromomethane	NA	ID	ID	ID	2.0E+6 (C)	<57	57
Dichlorodifluoromethane	ID	9.0E+5	1.4E+9	3.3E+12	1.0E+6 (C)	<57	57
Diethyl ether	ID	ID	ID	ID	ID	<280	280
Ethylbenzene (I)	360	87,000	2.2E+06	1.0E+10	140,000 (C)	<57	57

ENVIRO MATRIX, INC.

EM Project No. 05-008a

Phase II ESA

Coast Guard West Station

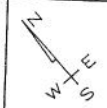
2660 East Atwater

Detroit, MI 48207

TABLE 1: SOIL ANALYTICAL DATA - VOC

VOLATILES	Part 201 Generic Cleanup Criteria Residential & Commercial I						
Sample ID	Groundwater	Indoor Air	Ambient Air Protection		Direct Contact Criteria & RBSLs	15	
Sample Depth (feet BSG)	Groundwater	Soil	Finite VSIC* for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs		1.5-3.0	
Date Collected	Surface Water	Volatilization to Indoor Air				4/25/2006	
Date Analyzed	Interface	Inhalation				4/28/2006	
Analytical Method No.	Protection	Criteria &				SW 8260B	
Collection Method	Criteria &	RBSLs				GRAB	
CONSTITUENT (µg/kg)	RBSLs	RBSLs				Conc	MDL
Ethylene dibromide	20 (M); 4.0	670	3,300	1.4E+7	92	<57	57
2-Hexanone	NA	990,000	1.4E+6	2.7E+9	2.5E+6 (C)	<2,800	2,800
Hexachlorobutadiene (C-46)	91	130,000	130,000	1.4E+8	100,000	<280	280
Hexachloroethane	310 (X)	40,000	9.3E+06	2.3E+8	230,000	<57	57
Isopropyl benzene	ID	390,000 (C)	2.8E+06	5.8E+9	390,000 (C)	<57	57
Methyl-tert-butyl ether (MTBE)	2,000 (X)	5.9E+6 (C)	8.7E+07	2.0E+11	1.5E+6	<280	280
2-Methylnaphthalene	ID	ID	ID	ID	8.1E+6	<280	280
Naphthalene	870	250,000	300,000	2.0E+8	1.6E+7	<280	280
n-Propylbenzene (I)	NA	ID	ID	1.3E+9	2.5E+6	<57	57
Styrene	2,200	250,000	1.4E+06	5.5E+9	400,000	<57	57
1,1,1-Trichloroethane	4,000	2.5E+5	2.8E+7	6.7E+10	4.6E+5 (C)	<57	57
1,1,2-Trichloroethane	6,600 (X)	4,600	44,000	1.9E+8	1.8E+5	<57	57
1,1,1,2-Tetrachloroethane	ID (X)	6,200	100,000	4.2E+8	4.4E+5 (C)	<57	57
1,1,2,2-Tetrachloroethane	1,600 (X)	4,300	14,000	5.4E+7	53,000	<57	57
1,1,2-Trichloro-1,2,2-trifluoroethane	1,700	5.5E+5 (C)	2.1E+9	5.1E+12	5.5E+5 (C)	<57	57
1,2,4-Trimethylbenzene (I)	570	1.1E+5 (C)	5.0E+8	8.2E+10	1.1E+5 (C)	<57	57
1,3,5-Trimethylbenzene (I)	1,100	94,000 (C)	3.8E+8	8.2E+10	94,000 (C)	<57	57
Tetrachloroethylene	900 (X)	11,000	1.1E+6	5.4E+9	88,000 (C)	<57	57
Toluene (I)	2,800	250,000 (C)	1.2E+07	2.7E+10	250,000 (C)	<57	57
Trichloroethylene	4,000 (X)	7,100	3.9E+5	1.8E+9	5.0E+5 (C, DD)	<57	57
Trichlorofluoromethane	NA	560,000 (C)	1.5E+09	3.8E+12	560,000 (C)	<57	57
1,2,3-Trichloropropane	NA	ID	ID	ID	830,000 (C)	<57	57
1,2,4-Trichlorobenzene	1,800	1.1E+6 (C)	2.8E+07	2.5E+10	990,000 (DD)	<280	280
Vinyl chloride	300	270	73,000	3.5E+8	3,800	<45	45
Xylenes (I)	700	150,000 (C)	1.3E+08	2.9E+11	150,000 (C)	<170	170

* VSIC = Volatile Soil Inhalation Criteria



EAST ATWATER STREET

DETROIT RIVER

VACANT / PARKING

SLIP

SLIP

PIER

CONCRETE / ASPHALT

SB 16 GRASS SB 15

SB 14

SB 18

GRASS

SB 17

VACANT

DATE	REVIEW FOR	PROJECT ARCHITECT	DEPT. HEAD/SUPV
1	RPT, 7/28/06	BR	KTR

FIG 2: SOIL BORING LOCATION MAP

US Coast Guard
Detroit West Station
2660 East Atwater
Detroit, MI 48207

NO.	DATE	BY	PROJECT ARCHITECT	DEPT. HEAD/SUPV
1	06/06/06	LK	BR	KTR

REVISIONS

CLIENT FILE NO. 06-000

ECONOMIC DEVELOPMENT
CORP. OF DETROIT

CONTRACT FILE NO. 06-000



ENVIRO MATRIX
ENGINEERING EXCELLENCE
183 MADISON SUITE 100 DETROIT, MICHIGAN 48207
PH: 313.964.1000
FAX: 313.964.1770

LEGEND

⊕ SOIL BORING LOCATION

DRAWING LAST MODIFIED 06/06/06	JOB NUMBER 06-000A
DRAWN BY LK	SCALE 1" = 30'
CHECKED BY BR	SHEET NUMBER FIGURE 2

TABLE 2: SOIL ANALYTICAL DATA - PNA AND METALS

Coast Guard West Station
2660 East Atwater
Detroit, MI 48207

PNAs	TABLE 2: SOIL ANALYTICAL DATA - PNA AND METALS																					
Sample ID	Part 201 Generic Cleanup Criteria Residential & Commercial I																					
Sample Depth (feet BSG)	Groundwater	Indoor Air	Ambient Air		Direct Contact Criteria & RBSLs																	
Date Collected	Groundwater Surface Water Interface Protection Criteria &	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Finite VSIC* for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs		14		14		15		16		17		18						
Date Analyzed						4.0-5.5		9.0-10.5		1.5-3.0		4.0-5.5		1.5-3.0		6.5-8.0						
Analytical Method No.						4/25/2006		4/25/2006		4/25/2006		4/25/2006		4/25/2006		4/25/2006						
Collection Method						5/5/2006		5/5/2006		5/5/2006		5/2/2006		5/5/2006		5/5/2006						
CONSTITUENT (µg/kg)						SW 8270C		SW 8270C		SW 8270C		SW 8270C		SW 8270C		SW 8270C						
	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB	GRAB					
	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL				
Acenaphthene	4,400		1.9E+8		8.1E+07		1.4E+10		4.1E+7		1,700	2,400	48	420	<370	370	<390	390	440	2,000	720	2,000
Acenaphthylene	ID		1.6E+6		2.2E+06		2.3E+9		1.6E+6		<2,400	2,400	<420	420	<370	370	<390	390	550	2,000	610	2,000
Anthracene	ID		1.0E+9 (D)		1.4E+09		6.7E+10		2.3E+8		3,000	2,400	110	420	<370	370	38	390	1,400	2,000	2,800	2,000
Benzo(a)anthracene (Q)	NLL		NLV		NLV		ID		20,000		2,900	2,400	130	420	46	370	170	390	4,000	2,000	6,600	2,000
Benzo(a)pyrene (Q)	NLL		NLV		NLV		ID		20,000		2,400	2,400	99	420	43	370	120	390	2,700	2,000	5,500	2,000
Benzo(b)fluoranthene	NLL		ID		ID		ID		20,000		3,200	2,400	140	420	61	370	190	390	3,900	2,000	6,800	2,000
Benzo(g,h,i)pyrene	NLL		NLV		NLV		ID		200,000		1,400	2,400	51	420	<370	370	60	390	1,200	2,000	2,200	2,000
Benzo(k)fluoranthene	NLL		NLV		NLV		ID		200,000		1,200	2,400	63	420	<370	370	<390	390	1,500	2,000	3,200	2,000
Chrysene (Q)	NLL		ID		ID		ID		2,000		3,900	2,400	200	420	64	370	160	390	3,700	2,000	6,600	2,000
Dibenzo(a,h)anthracene (Q)	NLL		NLV		NLV		ID		2,000		<2,400	2,400	<420	420	<370	370	<390	390	470	2,000	730	2,000
Fluoranthene	5,500		1.0E+9 (D)		7.4E+08		9.3E+9		4.6E+7		9,200	2,400	380	420	120	370	340	390	7,700	2,000	17,000	2,000
Fluorene	5,300		5.8E+8		1.3E+08		9.3E+9		2.7E+7		2,900	2,400	71	420	<370	370	<390	390	1,000	2,000	1,200	2,000
Indeno(1,2,3-cd)pyrene (Q)	NLL		NLV		NLV		ID		20,000		1,400	2,400	61	420	<370	370	<390	390	1,200	2,000	2,400	2,000
2-Methylnaphthalene	ID		ID		ID		ID		8.1E+6		210	2,400	37	420	<370	370	42	390	430	2,000	<2,000	2,000
Naphthalene	870		250,000		300,000		2.0E+8		1.6E+7		330	2,400	77	420	<370	370	47	390	330	2,000	480	2,000
Phenanthrene	5,300		2.8E+6		160,000		6.7E+6		1.6E+6		14,000	2,400	460	420	88	370	220	390	7,500	2,000	5,500	2,000
Pyrene	ID		1.0E+9 (D)		6.5E+08		6.7E+9		2.9E+7		7,500	2,400	320	420	100	370	260	390	6,800	2,000	14,000	2,000
* VSIC = Volatile Soil Inhalation Criteria																						

* VSIC = Volatile Soil Inhalation Criteria

METALS	Part 201 Generic Cleanup Criteria Residential & Commercial I																
Sample ID	Groundwater	Indoor Air	Ambient Air		Direct Contact Criteria & RBSLs	14		14		15		16		17		18	
Sample Depth (feet BSG)	Groundwater	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Finite VSIC* for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs		4.0-5.5		9.0-10.5		1.5-3.0		4.0-5.5		1.5-3.0		6.5-8.0	
Date Collected	Surface Water Interface Protection Criteria & RBSLs					4/25/2006		4/25/2006		4/25/2006		4/25/2006		4/25/2006		4/25/2006	
Date Analyzed						5/1/2006		5/1/2006		5/1/2006		5/1/2006		5/1/2006		5/1/2006	
Analytical Method No.						SW 6020A & 7471A		SW 6020A & 7471A		SW 6020A & 7471A		SW 6020A & 7471A		SW 6020A & 7471A		SW 6020A & 7471A	
Collection Method						GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
CONSTITUENT (µg/kg)	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	Conc	MDL	
Arsenic	23,000 (X)	NLV	NLV	720,000	7,600		11,000 240	7,800 240	6,300 210	7,500 220	8,400 240	7,000 240					
Barium	1.2E+6 (G,X)	NLV	NLV	3.3E+8	3.7E+7	440,000 2,400	110,000 2,400	67,000 2,100	55,000 2,200	92,000 2,400	57,000 2,400	2,400					
Cadmium	3,000 (G,X)	NLV	NLV	1.7E+6	550,000	600 480	530 480	540 420	450 440	670 470	370 470						
Chromium	3.5E+9 (G,X)	NLV	NLV	3.3E+8	7.9E+8	15,000 4,800	16,000 4,800	15,000 4,200	12,000 4,400	18,000 4,700	14,000 4,700						
Copper	4.6E+6 (G)	NLV	NLV	1.3E+8	2.0E+7	99,000 2,400	36,000 2,400	82,000 2,100	110,000 2,200	68,000 2,400	26,000 2,400						
Lead	2.5E+6 (G,X)	NLV	NLV	1.0E+8	400,000	510,000 2,400	120,000 2,400	66,000 2,100	57,000 2,200	260,000 2,400	85,000 2,400						
Mercury	50 (M); 1.2	48,000	52,000	2.0E+7	160,000	280 18	140 26	170 20	1,100 180	210 20	730 49						
Selenium	400	NLV	NLV	1.3E+8	2.6E+6	630 480	<480 480	850 420	420 440	640 470	880 470						
Silver	100 (M); 27	NLV	NLV	6.7E+6	2.5E+6	300 240	170 240	74 210	140 220	130 240	160 240						
Zinc	4.5E+6 (G)	NLV	NLV	ID	1.7E+8	380,000 2,400	120,000 2,400	110,000 2,100	85,000 2,200	130,000 2,400	61,000 2,400						
* VSIC = Volatile Soil Inhalation Criteria																	

* VSIC = Volatile Soil Inhalation Criteria



FOOTNOTES

FOR THE PART 201 CRITERIA/
PART 213 RISK-BASED SCREENING LEVELS
RRD OPERATIONAL MEMORANDUM No. 1

- (A) Criterion is the state of Michigan drinking water standard established pursuant to Section 5 of 1976 PA 399, MCL 325.1005.
- (B) Background, as defined in R 299.5701(b), may be substituted if higher than the calculated cleanup criterion. Background levels may be less than criteria for some inorganic compounds.
- (C) Value presented is a screening level based on the chemical-specific generic soil saturation concentration (C_{sat}) since the calculated risk-based criterion is greater than C_{sat} . Concentrations greater than C_{sat} are acceptable cleanup criteria for this pathway where a site-specific demonstration indicates that free-phase material containing a hazardous substance is not present.
- (D) Calculated criterion exceeds 100 percent, hence it is reduced to 100 percent or 1.0E+9 parts per billion (ppb).
- (E) Criterion is the aesthetic drinking water value, as required by Section 20120a(5) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A notice of aesthetic impact may be employed as an institutional control mechanism if groundwater concentrations exceed the aesthetic drinking water criterion, but do not exceed the applicable health-based drinking water value provided in the following table:

Hazardous Substance	Chemical Abstract Service Number	Residential Health-Based Drinking Water Value	Industrial-Commercial Health-Based Drinking Water Value
Aluminum	7429905	300	4,100
tertiary Amyl methyl ether	994058	910	2,600
Copper	7440508	1,400	4,000
Diethyl ether	60297	3,700	10,000
Ethylbenzene	100414	700	700
Iron	7439896	2,000	5,600
Manganese	7439965	860	2,500
Methyl-tert-butyl ether (MTBE)	1634044	240	690
Toluene	108883	1,000	1,000
1,2,4-Trimethylbenzene	95636	1,000	2,900
1,3,5-Trimethylbenzene	108678	1,000	2,900
Xylenes	1330207	10,000	10,000

- (F) Criterion is based on adverse impacts to plant life and phytotoxicity.
- (G) Groundwater surface water interface (GSI) criterion depends on the pH or water hardness, or both, of the receiving surface water. The final chronic value (FCV) for the protection of aquatic life shall be calculated based on

the pH or hardness of the receiving surface water. Where water hardness exceeds 400 mg CaCO₃/L, use 400 mg CaCO₃/L for the FCV calculation. The FCV formula provides values in units of ug/L or ppb. The generic GSI criterion is the lesser of the calculated FCV, the wildlife value (WV), and the surface water human non-drinking water value (HNDV). The soil GSI protection criteria for these hazardous substances are the greater of the 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	FCV Formula ug/L	FCV Conversion Factor (CF)	WV ug/L	HNDV ug/L
Acetate	$\text{EXP}(0.2732 \cdot (\text{pH}) + 7.0362)$	NA	NA	1.3E+6
Barium [⊗]	$\text{EXP}(1.0629 \cdot (\text{LnH}) + 1.1869)$	NA	NA	1.6E+5
Beryllium	$\text{EXP}(2.5279 \cdot (\text{LnH}) - 10.7689)$	NA	NA	1,200
Cadmium [⊗]	$(\text{EXP}(0.7852 \cdot (\text{LnH}) - 2.715)) \cdot \text{CF}$	$1.101672 - ((\text{LnH}) \cdot (0.041838))$	NA	130
Chromium (III) [⊗]	$(\text{EXP}(0.819 \cdot (\text{LnH}) + 0.6848)) \cdot \text{CF}$	0.86	NA	9,400
Copper	$(\text{EXP}(0.8545 \cdot (\text{LnH}) - 1.702)) \cdot \text{CF}$	0.96	NA	64,000
Lead [⊗]	$(\text{EXP}(1.273 \cdot (\text{LnH}) - 3.296)) \cdot \text{CF}$	$1.46203 - ((\text{LnH}) \cdot (0.14571))$	NA	190
Manganese	$\text{EXP}(0.8784 \cdot (\text{LnH}) + 3.5199)$	NA	NA	59,000
Nickel	$(\text{EXP}(0.846 \cdot (\text{LnH}) + 0.0584)) \cdot \text{CF}$	0.997	NA	2.1E+5
Pentachlorophenol	$\text{EXP}(1.005 \cdot (\text{pH}) - 5.134)$	NA	NA	2.8
Zinc	$(\text{EXP}(0.8473 \cdot (\text{LnH}) + 0.884)) \cdot \text{CF}$	0.986	NA	22,000

where,

- EXP(x) = The base of the natural logarithm raised to power x (e^x).
- LnH = The natural logarithm of water hardness in mg CaCO₃/L.
- * = The multiplication symbol.
- ⊗ = The GSI criterion developed here may not be protective for surface water that is used as a drinking water source. Refer to footnote (X) for further guidance.

A spreadsheet that may be used to calculate GSI and GSI protection criteria for (G)-footnoted hazardous substances is available on the Department of Environmental Quality (DEQ) internet web site.

- (H) Valence-specific chromium data (Cr III and Cr VI) shall be compared to the corresponding valence-specific cleanup criteria. If both Cr III and Cr VI are present in groundwater, the total concentration of both cannot exceed the drinking water criterion of 100 ug/L. If analytical data are provided for total chromium only, they shall be compared to the cleanup criteria for Cr VI. Cr III soil cleanup criterion for protection of drinking water can only be used at sites where groundwater is prevented from being used as a public water supply, currently and in the future, through an approved land or resource use restriction.
- (I) Hazardous substance may exhibit the characteristic of ignitability as defined in 40 C.F.R. §261.21 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these

rules of \$45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, Remediation and Redevelopment Division (RRD), 525 West Allegan Street, Lansing, Michigan 48933, at cost.

- (J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations shall be added together for comparison to criteria.
- (K) Hazardous substance may be flammable or explosive, or both.
- (L) Criteria for lead are derived using a biologically based model, as allowed for under Section 20120a(10) of the NREPA, and are not calculated using the algorithms and assumptions specified in pathway-specific rules. The generic residential drinking water criterion of 4 ug/L is linked to the generic residential soil direct contact criterion of 400 mg/kg. A higher concentration in the drinking water, up to the state action level of 15 ug/L, may be allowed as a site-specific remedy and still allow for drinking water use, under Section 20120a(2) of the NREPA if soil concentrations are appropriately lower than 400 mg/kg. If a site-specific criterion is approved based on this subdivision, a notice shall be filed on the deed for all property where the groundwater concentrations will exceed 4 ug/L to provide notice of the potential for unacceptable risk if soil or groundwater concentrations increase. Acceptable combinations of site-specific soil and drinking water concentrations are presented in the following table:

Acceptable Combinations of Lead in Drinking Water and Soil	
Drinking Water Concentration (ug/L)	Soil Concentration (mg/kg)
5	386-395
6	376-385
7	376-385
8	366-375
9	356-365
10	346-355
11	336-345
12	336-345
13	326-335
14	316-325
15	306-315

- (M) Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit.
- (N) The concentrations of all potential sources of nitrate-nitrogen (e.g., ammonia-N, nitrite-N, nitrate-N) in groundwater that is used as a source of drinking water shall not, when added together, exceed the nitrate drinking water criterion of 10,000 ug/L. Where leaching to groundwater is a relevant pathway, soil concentrations of all potential sources of nitrate-nitrogen shall not, when added together, exceed the nitrate drinking water protection criterion of 2.0E+5 ug/kg.
- (O) The concentration of all polychlorinated and polybrominated dibenzodioxin and dibenzofuran isomers present at a facility, expressed as an equivalent

concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based upon their relative potency, shall be added together and compared to the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin. The generic cleanup criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin are not calculated according to the algorithms presented in R 299.5714 to R 299.5726. The generic cleanup criteria are being held at the values that the DEQ has used since August 1998, in recognition of the fact that national efforts to reassess risks posed by dioxin are not yet complete. Until these studies are complete, it is premature to select a revised slope factor and/or reference dose for calculation of generic cleanup criteria.

- (P) Amenable cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with all groundwater criteria. Total cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with soil criteria. Industrial-commercial direct contact criteria may not be protective of the potential for release of hydrogen cyanide gas. Additional land or resource use restrictions may be necessary to protect for the acute inhalation concerns associated with hydrogen cyanide gas.
- (Q) Criteria for carcinogenic polycyclic aromatic hydrocarbons were developed using relative potential potencies to benzo(a)pyrene.
- (R) Hazardous substance may exhibit the characteristic of reactivity as defined in 40 C.F.R. §261.23 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of \$45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost.
- (S) Criterion defaults to the hazardous substance-specific water solubility limit.
- (T) Refer to the federal Toxic Substances Control Act (TSCA), 40 C.F.R. §761, Subpart D and 40 C.F.R. §761, Subpart G, to determine the applicability of TSCA cleanup standards. Subpart D and Subpart G of 40 C.F.R. §761 (July 1, 2001) are adopted by reference in these rules and are available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulations may be purchased, at a cost as of the time of adoption of these rules of \$55, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401, or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost. Alternatives to compliance with the TSCA standards listed below are possible under 40 C.F.R. §761 Subpart D. New releases may be subject to the standards identified in 40 C.F.R. §761, Subpart G. Use Part 201 soil direct contact cleanup criteria in the following table if TSCA standards are not applicable.

Land Use Category	TSCA, Subpart D Cleanup Standards	Part 201 Soil Direct Contact Cleanup Criteria
Residential & Commercial I	1,000 ppb, or 10,000 ppb if capped	4,000 ppb
Industrial & Commercial II	1,000 ppb, or 10,000 ppb if capped	16,000 ppb
Commercial III	1,000 ppb, or 10,000 ppb if capped	33,000 ppb
Commercial IV	1,000 ppb, or 10,000 ppb if capped	22,000 ppb

- (U) Hazardous substance may exhibit the characteristic of corrosivity as defined in 40 C.F.R. §261.22 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of \$45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost.
- (V) Criterion is the aesthetic drinking water value as required by Section 20120(a)(5) of the NREPA. Concentrations up to 200 ug/L may be acceptable, and still allow for drinking water use, as part of a site-specific cleanup under Section 20120a(2) of the NREPA.
- (W) Concentrations of trihalomethanes in groundwater shall be added together to determine compliance with the Michigan drinking water standard of 80 ug/L. Concentrations of trihalomethanes in soil shall be added together to determine compliance with the drinking water protection criterion of 1,600 ug/kg.
- (X) The GSI criterion shown in the generic cleanup criteria tables is not protective for surface water that is used as a drinking water source. For a groundwater discharge to the Great Lakes and their connecting waters or discharge in close proximity to a water supply intake in inland surface waters, the generic GSI criterion shall be the surface water human drinking water value (HDV) listed in the table in this footnote, except for those HDV indicated with an asterisk. For HDV with an asterisk, the generic GSI criterion shall be the lowest of the HDV, the WV, and the calculated FCV. See formulas in footnote (G). Soil protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria for compounds with an asterisk shall be the greater of 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Calculation of Generic Facility-Specific Part 201 Groundwater Surface Water Interface (GSI) Criteria for {G} Footnoted Hazardous Substances

Directions for calculating generic facility-specific GSI criteria:

1. Enter "hardness" (Column C) or "pH" (Column D). Click the green check mark to the left of the Excel formula bar or press the "Enter" key.
2. The GSI criteria for surface water not protected as a source of drinking water are the lower of the final chronic value (FCV), wildlife value (WV), and the surface water human non-drinking water value (HNDV). These criteria are presented in Column L.
3. The GSI criteria for surface water protected as a source of drinking water are the lower of the FCV, WV, and surface water human drinking water value (HDV). Surface water protected as a source of drinking water includes the Great Lakes and their connecting waters, and inland surface water in close proximity to a water supply intake. These criteria are presented in Column M. Refer to Part 201 Criteria Application Guidesheet #3 for further guidance on selecting the applicable GSI criterion.
4. The final acute values (FAV) protective of aquatic life are presented in column E. The calculation of the FAV is provided to allow the identification of any exceedance of an acute GSI criterion. Where an exceedance of an acute GSI criterion exists, an evaluation must be done to determine appropriate action in accordance with provisions of R 299.5716, R 299.5526(4) and RRD Operational Memorandum No. 5.

Calculate GSI in ug/L (ppb)												
Hazardous Substance	Chemical Abstract Service Number (CAS #)	* ENTER Hardness in mg CaCO ₃ /L	* ENTER pH	Final Acute Value (FAV)	FAV Conversion Factor	Final Chronic Value (FCV)	FCV Conversion Factor	Wildlife Value (WV)	Surface Water Human Non-Drinking Water Value (HNDV)	Surface Water Human Drinking Water Value (HDV)	GSI Criteria for Surface Water Not Protected for Drinking Water Use	GSI Criteria for Surface Water Protected for Drinking Water Use
Acetate	71501	NA	pH	Calculated	NA	Calculated	NA	NA	1.3E+6	16,000	Calculated	Calculated
Barium	7440393	hardness	NA	Calculated	NA	Calculated	NA	NA	1.6E+5	1,900	Calculated	Calculated
Beryllium	7440417	hardness	NA	Calculated	NA	Calculated	NA	NA	1,200	160	Calculated	Calculated
Cadmium	7440439	hardness	NA	Calculated	Calculated	Calculated	Calculated	NA	130	3	Calculated	Calculated
Chromium (III)	16065831	hardness	NA	Calculated	NA	Calculated	0.85	NA	9,400	120	Calculated	Calculated
Copper	7440508	hardness	NA	Calculated	NA	Calculated	0.95	NA	64,000	790	Calculated	Calculated
Lead	7439921	hardness	NA	Calculated	Calculated	Calculated	Calculated	NA	190	14	Calculated	Calculated
Manganese	7439965	hardness	NA	Calculated	NA	Calculated	NA	NA	59,000	3,600	Calculated	Calculated
Nickel	7440020	hardness	NA	Calculated	NA	Calculated	0.997	NA	2.1E+5	2,600	Calculated	Calculated
Zinc	7440666	hardness	NA	Calculated	NA	Calculated	0.986	NA	22,000	4,500	Calculated	Calculated
Pentachlorophenol	87865	NA	pH	Calculated	NA	Calculated	NA	NA	2.8	1.8	Calculated	Calculated

NA = Criterion or value is not available or not applicable.

* The formulas in this spreadsheet depend upon appropriate entries in these cells. Do not leave these cells blank. If numeric hardness or pH values are not available, enter the word "hardness" or "pH" in the appropriate cell.

Calculation of Generic Facility-Specific Part 201 Soil GSI Protection Criteria (GSI PC)

Directions for calculating a generic facility-specific soil GSI PC:

1. Enter the "GSI" criterion calculated on the previous page, rounded to 2 significant figures. Click the green check mark to the left of the Excel formula bar or press the "Enter" key.
2. The GSI PC will calculate and appear in Column W. The GSI PC are the higher of the Soil-Water Partition Value for GSI (Column U) and the 20 X GSI value (Column V).

Calculate Soil GSI PC in ug/Kg (ppb)								
Hazardous Substance	Chemical Abstract Service Number (CAS #)	* ENTER GSI	Soil-Water Distribution Coefficients (Kd) L/Kg	Henry's Law Constant (HLC) atm-m ³ /mol	Soil Organic Carbon-Water Partition Coefficient (Koc) L/Kg	Soil-Water Partition Value for GSI ug/Kg	20 X GSI ug/Kg	Soil GSI PC ug/Kg
Acetate	71501	16,000	NA	NA	NA	NA	3.2E+5	3.2E+5
Barium	7440393	1,900	41	NA	NA	1.2E+6	3.8E+4	1.2E+6
Beryllium	7440417	160	790	NA	NA	2.0E+6	3.2E+3	2.0E+6
Cadmium	7440439	3	75	NA	NA	3.0E+3	5.0E+1	3.0E+3
Chromium (III)	16065831	120	1.8E+6	NA	NA	3.5E+9	2.4E+3	3.5E+9
Copper	7440508	790	360	NA	NA	4.6E+6	1.6E+4	4.6E+6
Lead	7439921	14	11,000	NA	NA	2.5E+6	2.8E+2	2.5E+6
Manganese	7439965	3,600	NA	NA	NA	NA	7.2E+4	7.2E+4
Nickel	7440020	2,600	65	NA	NA	2.7E+6	5.2E+4	2.7E+6
Zinc	7440666	4,500	62	NA	NA	4.5E+6	9.0E+4	4.5E+6
Pentachlorophenol	87865	2	NA	2.44E-8	592	1.7E+4	3.6E+1	1.7E+4

NA = Criterion or value is not available or not applicable.

* The formulas in this spreadsheet depend upon appropriate entries in these cells. Do not leave these cells blank. If numeric GSI values are not available, enter "GSI" in the appropriate cell.



Hazardous Substance	Chemical Abstract Service Number	Surface Water Human Drinking Water Values (HDV) (ug/L)	Soil GSI Protection Criteria for HDV (ug/kg)
Acrylonitrile	107131	2.0 (M); 0.87	100 (M); 17
Alachlor	15972608	3.5	91
Antimony	7440360	2	1,400
Arsenic	7440382	50	23,000
Atrazine	1912249	4.3	86
Barium	7440393	1,900*	*
Benzene	71432	12	240
bis(2-Chloroethyl)ether	111444	1 (M); 0.79	100 (M); 20
Bromate	15541454	10 (M); 0.5	200 (M); 10
Butyl benzyl phthalate	85687	6.9	13,000
Cadmium	7440439	2.5*	*
Carbon tetrachloride	56235	5.6	110
Chloride	16887006	50,000	1.0E+6
Chloroform	67663	77	1,500
Chromium (III)	16065831	120*	*
Cyanazine	21725462	2 (M); 0.93	200 (M); 40
3,3'-Dichlorobenzidine	91941	0.3 (M); 0.14	2,000 (M); 7.7
1,2-Dichloroethane	107062	6	120
1,1-Dichloroethylene	75354	24	480
1,2-Dichloropropane	78875	9.1	180
N,N-Dimethylacetamide	127195	700	14,000
1,4-Dioxane	123911	34	680
Ethylene dibromide	106934	0.05 (M); 0.006	20 (M); 1.0
Ethylene glycol	107211	56,000	1.1E+6
Heptachlor	76448	0.01 (M); 0.0017	NLL
beta-Hexachlorocyclohexane	319857	0.024	20 (M)
Hexachloroethane	67721	5.3	310
Isophorone	78591	310	6,200
Isopropyl alcohol	67630	28,000	5.6E+5
Lead	7439921	14*	*
Manganese	7439965	3600	72,000
Methyl-tert-butyl ether (MTBE)	1634044	100	2,000
Methylene chloride	75092	47	940
Mirex	2385855	0.02 (M); 1.6E-5	NLL
Molybdenum	7439987	120	2,400
Nitrobenzene	98953	4.7	330 (M); 94
Pentachlorophenol	87865	1.8*	*
1,2,4,5-Tetrachlorobenzene	95943	2.8	3,300
1,1,1,2-Tetrachloroethane	630206	19	380
1,1,2,2-Tetrachloroethane	79345	3.2	64
Tetrachloroethylene	127184	11	220
Tetrahydrofuran	109999	350	7,000
Thallium	7440280	2.0 (M); 1.2	2,300
1,1,2-Trichloroethane	79005	12	240
Trichloroethylene	79016	29	580

- (Y) Source size modifiers shown in the following table shall be used to determine soil inhalation criteria for ambient air when the source size is not one-half acre. The modifier shall be multiplied by the generic soil inhalation criteria shown in the table of generic cleanup criteria to determine the applicable criterion.

Source Size sq. feet or acres	Modifier
400 sq feet	3.17
1000 sq feet	2.2
2000 sq feet	1.76
1/4 acre	1.15
1/2 acre	1
1 acre	0.87
2 acre	0.77
5 acre	0.66
10 acre	0.6
32 acre	0.5
100 acre	0.43

- (Z) Mercury is typically measured as total mercury. The generic cleanup criteria, however, are based on data for different species of mercury. Specifically, data for elemental mercury, chemical abstract service (CAS) number 7439976, serve as the basis for the soil volatilization to indoor air criteria, groundwater volatilization to indoor air, and soil inhalation criteria. Data for methyl mercury, CAS number 22967926, serve as the basis for the GSI criterion; and data for mercuric chloride, CAS number 7487947, serve as the basis for the drinking water, groundwater contact, soil direct contact, and the groundwater protection criteria. Comparison to criteria shall be based on species-specific analytical data only if sufficient facility characterization has been conducted to rule out the presence of other species of mercury.
- (AA) Comparison to these criteria may take into account an evaluation of whether the hazardous substances are adsorbed to particulates rather than dissolved in water and whether filtered groundwater samples were used to evaluate groundwater.
- (BB) The state drinking water standard for asbestos is in units of fibers per milliliter of water (f/mL) longer than 10 millimicrons. Soil concentrations of asbestos are determined by polarized light microscopy.
- (CC) Groundwater: The generic GSI criteria are based on the toxicity of unionized ammonia (NH_3); the criteria are 29 ug/L and 53 ug/L for cold water and warm water surface water, respectively. As a result, the GSI criterion shall be compared to the percent of the total ammonia concentration in the groundwater that will become NH_3 in the surface water. This percent NH_3 is a function of the pH and temperature of the receiving surface water and can be estimated using the following table,



taken from Emerson, et al., (Journal of the Fisheries Research Board of
Canada, Volume 32(12):2382, 1975).

Percent NH_3 in Aqueous Ammonia Solutions for 0-30 °C and pH 6-10

Temp (°F)	Temp (°C)	pH								
		6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
32.0	0	0.00827	0.0261	0.0826	0.261	0.820	2.55	7.64	20.7	45.3
33.8	1	0.00899	0.0284	0.0898	0.284	0.891	2.77	8.25	22.1	47.3
35.6	2	0.00977	0.0309	0.0977	0.308	0.968	3.00	8.90	23.6	49.4
37.4	3	0.0106	0.0336	0.106	0.335	1.05	3.25	9.60	25.1	51.5
39.2	4	0.0115	0.0364	0.115	0.363	1.14	3.52	10.3	26.7	53.5
41.0	5	0.0125	0.0395	0.125	0.394	1.23	3.80	11.1	28.3	55.6
42.8	6	0.0136	0.0429	0.135	0.427	1.34	4.11	11.9	30.0	57.6
44.6	7	0.0147	0.0464	0.147	0.462	1.45	4.44	12.8	31.7	59.5
46.4	8	0.0159	0.0503	0.159	0.501	1.57	4.79	13.7	33.5	61.4
48.2	9	0.0172	0.0544	0.172	0.542	1.69	5.16	14.7	35.3	63.3
50.0	10	0.0186	0.0589	0.186	0.586	1.83	5.56	15.7	37.1	65.1
51.8	11	0.0201	0.0637	0.201	0.633	1.97	5.99	16.8	38.9	66.8
53.6	12	0.0218	0.0688	0.217	0.684	2.13	6.44	17.9	40.8	68.5
55.4	13	0.0235	0.0743	0.235	0.738	2.30	6.92	19.0	42.6	70.2
57.2	14	0.0254	0.0802	0.253	0.796	2.48	7.43	20.2	44.5	71.7
59.0	15	0.0274	0.0865	0.273	0.859	2.67	7.97	21.5	46.4	73.3
60.8	16	0.0295	0.0933	0.294	0.925	2.87	8.54	22.8	48.3	74.7
62.6	17	0.0318	0.101	0.317	0.996	3.08	9.14	24.1	50.2	76.1
64.4	18	0.0343	0.108	0.342	1.07	3.31	9.78	25.5	52.0	77.4
66.2	19	0.0369	0.117	0.368	1.15	3.56	10.5	27.0	53.9	78.7
68.0	20	0.0397	0.125	0.396	1.24	3.82	11.2	28.4	55.7	79.9
69.8	21	0.0427	0.135	0.425	1.33	4.10	11.9	29.9	57.5	81.0
71.6	22	0.0459	0.145	0.457	1.43	4.39	12.7	31.5	59.2	82.1
73.4	23	0.0493	0.156	0.491	1.54	4.70	13.5	33.0	60.9	83.2
75.2	24	0.0530	0.167	0.527	1.65	5.03	14.4	34.6	62.6	84.1
77.0	25	0.0569	0.180	0.566	1.77	5.38	15.3	36.3	64.3	85.1
78.8	26	0.0610	0.193	0.607	1.89	5.75	16.2	37.9	65.9	85.9
80.6	27	0.0654	0.207	0.651	2.03	6.15	17.2	39.6	67.4	86.8
82.4	28	0.0701	0.221	0.697	2.17	6.56	18.2	41.2	68.9	87.3
84.2	29	0.0752	0.237	0.747	2.32	7.00	19.2	42.9	70.4	88.3
86.0	30	0.0805	0.254	0.799	2.48	7.46	20.3	44.6	71.8	89.0

The generic approach for estimating NH_3 assumes a default pH of 8 and default temperatures of 68°F and 85°F for cold water and warm water surface water, respectively. The resulting percent NH_3 is 3.8 percent and 7.2 percent for cold water and warm water, respectively. This default percentage shall be multiplied by the total ammonia-nitrogen ($\text{NH}_3\text{-N}$) concentration in the groundwater and the resulting NH_3 concentration

compared to the applicable GSI criterion. As an alternative, the maximum pH and temperature data from the specific receiving surface water can be used to estimate, from the table in this footnote, a lower percent unionized ammonia concentration for comparison to the generic GSI.

Soil: The generic soil GSI protection criteria for unionized ammonia are 580 ug/kg and 1,100 ug/kg for cold water and warm water surface water, respectively.

- (DD) Hazardous substance causes developmental effects. Residential and commercial I direct contact criteria are protective of both prenatal and postnatal exposure. Industrial and commercial II, III and IV direct contact criteria are protective for a pregnant adult receptor.
- (EE) The following are applicable generic GSI criteria as required by Section 20120a(15) of the NREPA.

Hazardous Substance	GSI (ug/L)	Notes
Phosphorus	1,000	Criteria applicable unless receiving water is a surface water that has a phosphorus waste load allocation or is an inland lake. In those cases, contact the department for applicable values.
Total dissolved solids (TDS)	5.0E+5	If TDS data are not available, the TDS criterion may be used a screening level for the sum of the concentrations of the following substances: Calcium, Chlorides, Iron, Magnesium, Potassium, Sodium, Sulfate.
Dissolved Oxygen (DO): Cold receiving waters Warm receiving waters	$\geq 7,000$ $\geq 5,000$	Since a low level of DO can be harmful to aquatic life, the criterion represents a minimum level that on-site samples must exceed. This is in contrast to other criteria which represent "not to exceed" concentrations. DO criteria are not applicable if groundwater Carbonaceous Biochemical Oxygen Demand (CBOD) is less than 10,000 ug/L and groundwater ammonia concentration is less than 2,000 ug/L.

- (FF) The chloride GSI criterion shall be 125 mg/l when the discharge is to surface waters of the state designated as public water supply sources or 50 mg/l when the discharge is to the Great Lakes or connecting waters. Chloride GSI criteria shall not apply for surface waters of the state that are not designated as a public water supply source, however, the total dissolved solids criterion is applicable.
- (GG) Risk-based criteria are not available for methane due to insufficient toxicity data. An acceptable soil gas concentration (presented for both residential and commercial/industrial land uses) was derived utilizing 25 percent of the lower explosive level for methane. This equates to 1.25 percent or $8.4\text{E}+6 \text{ ug/m}^3$.

"ID" means insufficient data to develop criterion.

"NA" means a criterion or value is not available or, in the case of background and CAS numbers, not applicable.



"NLL" means hazardous substance is not likely to leach under most soil conditions.

"NLV" means hazardous substance is not likely to volatilize under most conditions.



McDOWELL & ASSOCIATES
Geotechnical, Environmental, & Hydrogeologic Services
21355 Hatcher Avenue • Ferndale, MI 48220
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LOG OF SOIL
BORING NO. 14

PROJECT

EnviroMatrix, Inc./EDC
Coast Guard Station Addition

JOB NO. 06-093

LOCATION

2660 Atwater Street

SURFACE ELEV.

DATE 4-25-06

Detroit, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
			0'3" CRACKED ASPHALT						
	1								
			Moist discolored brown gravelly SAND, fill						
A	2			10					
UL			1'9" Very compact moist black fine to medium SAND & GRAVEL, fill	11					
	3			7					
B	4		3'8" Compact moist black coarse SAND with brick, slag, clay layers and occasional metal pieces, fill	4	Sample collected	4.0'-5.5'			
UL	5			6					
	6			11					
C	7		6'0" Soft to firm moist dark brown sandy silty CLAY with blue silty clay layers and trace of pebbles, fill	2					
UL	8			2					
	9			3					
D	10		9'0" Stiff moist discolored dark brown silty CLAY with wood, traces of brick and blue clay layers, fill	5	Sample collected	9.0'-10.5'			
UL	11			3					
	12			5					
	13								
	14								
E	15		14'0" Compact moist discolored brown clayey SAND with brick, trace of wood and occasional clay layers, fill	4					
UL	16			5					
	17			6					
	18								
	19								
F	20		17'6" Very compact moist gray clayey fine to medium SAND with trace of gravel and occasional clay layers	12					
UL	21			11					
	22			8					
	23								
	24		22'0" Stiff moist blue sandy silty CLAY with pebbles, occasional stones and wet sand layers						
G	25			4					
UL				5					
				11					
			25'6"						

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
() - PENETROMETER

REMARKS:
Standard Penetration Test - Driving 2" OD Sampler 1' With
140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS
G.W. ENCOUNTERED AT 22 FT. 0 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION dry FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES light



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LOG OF SOIL

BORING NO. 15

PROJECT EnviroMatrix, Inc./EDC
Coast Guard Station Addition

JOB NO. 06-093

LOCATION 2660 Atwater Street

SURFACE ELEV.

DATE 4-25-06

Detroit, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
	1		0'7" Moist dark brown sandy TOPSOIL, fill						
A	2								
UL				3					
	3		Compact to very compact moist discolored brown silty fine to medium SAND with clay layers and occasional concrete fragments, fill	13					
				10					
	4								
B			4'0" Compact moist brown silty fine to medium SAND with wood, fill	5					
UL	5			3					
			4'10"	4					
	6		6'0" Firm moist blue silty CLAY with traces of pebbles and wood, fill						
C	7			2					
UL				3					
	8		Firm moist blue silty CLAY with pebbles, fill	4					
	9								
D			9'0"	1					
UL	10			3					
				4					
	11								
			Soft to firm moist blue silty CLAY with pebbles, wood and occasional organic layers, fill						
	12								
	13		12'6"						
	14								
E			Stiff moist variegated sandy silty CLAY with pebbles and occasional wet sand seams	3					
UL	15			7					
				7					
	16		15'6"						
	17								
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
() - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With
140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 12 FT. 6 INS.
G.W. ENCOUNTERED AT dry FT. INS.
G.W. AFTER COMPLETION FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES light



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LOG OF SOIL

BORING NO. 16

PROJECT EnviroMatrix, Inc./EDC
Coast Guard Station Addition

JOB NO. 06-093

LOCATION 2660 Atwater Street

SURFACE ELEV. _____

DATE 4-25-06

Detroit, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
	1		Moist dark brown sandy TOPSOIL with vegetation, fill						
A	2		1'5"	2					
UL	3		Soft to firm moist brown silty CLAY with stones and occasional sand layers, fill	2					
	4		3'6"	4					
B	5		Stiff to firm moist variegated silty CLAY with wet sand layers and traces of concrete and brick, fill	5	Sample collected	4.0'-5.5'			
UL	6		5'4"	3					
	7		6'6"	4					
C	8		Firm moist blue silty CLAY with pebbles, possible fill	4					
UL	9		6'6"	2					
	10		9'6"	3					
D	11		Firm moist blue silty CLAY with pebbles and occasional discolored clay layers with vegetation, possible fill	3					
UL	12		9'6"	5					
	13		12'6"	2					
	14		Very stiff to extremely stiff moist brown sandy CLAY with pebbles	3					
E	15		15'6"	11					
UL	16			13					
	17			15					
	18								
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPUT SPOON
R.C. - ROCK CORE
() - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With
140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 3 FT. 6 INS.
G.W. ENCOUNTERED AT FT. INS.
G.W. AFTER COMPLETION none FT. INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES light



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LOG OF SOIL
BORING NO. 17

PROJECT EnviroMatrix, Inc./EDC
Coast Guard Station Addition

JOB NO. 06-093

LOCATION 2660 Atwater Street

SURFACE ELEV. DATE 4-25-06

Detroit, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
	1		0'6" Moist dark brown sandy TOPSOIL, fill						
A	2			3	Sample	collected	1.5'-3.0'		
UL	3		Firm to stiff moist discolored variegated silty CLAY with pebbles, brick, sand layers and trace of coal, fill	4					
	4			4					
B	5		3'9" Firm moist blue silty sandy CLAY with pebbles, possible fill	3					
UL	6			3					
	7			4					
C	8		7'6" Soft moist blue silty sandy CLAY with pebbles, possible fill	3					
UL	9			2					
	10		8'9" Soft moist variegated silty CLAY with vegetation and wet organic sand layers	2					
D	11								
UL	12			3					
	13			1					
	14			2					
E	15		12'0" Very stiff to extremely stiff moist brown sandy CLAY with pebbles	9					
UL	16			13					
	17			17					
	18		15'6"						
	19								
	20								
	21								
	22								
	23								
	24								
	25								

TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
() - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With
140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT	8	FT.	9	INS.
G.W. ENCOUNTERED AT		FT.		INS.
G.W. AFTER COMPLETION	dry	FT.		INS.
G.W. AFTER	HRS.	FT.		INS.
G.W. VOLUMES	light			



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LOG OF SOIL
BORING NO. 18

PROJECT EnviroMatrix, Inc./EDC
Coast Guard Station Addition

JOB NO. 06-093

LOCATION 2660 Atwater Street

SURFACE ELEV. DATE 4-25-06

Detroit, Michigan

Sample & Type	Depth	Legend	SOIL DESCRIPTION	Penetration Blows for 6"	Moisture %	Natural Wt. P.C.F.	Dry Den Wt. P.C.F.	Unc. Comp. Strength PSF	Str. %
	1		0'5" ASPHALT						
A	2			4					
UL	3		Compact moist discolored brown silty fine to medium SAND with trace of gravel and clay layers, fill	8					
	4			5					
B	5		3'9"						
UL	6		Soft moist variegated silty CLAY with traces of pebbles and discolored black streaks, fill	2					
	7			1					
	8			2					
C	9		6'8"						
UL	10		Slightly compact wet brown clayey SAND with vegetation and clay layers, fill	2					
	11			1					
	12			3					
	13		8'6"						
D	14			2					
UL	15		Soft moist brown sandy CLAY with variegated clay layers and trace of asphalt, fill	1					
	16			2					
	17								
	18		12'6"						
	19								
E	20		Firm moist blue sandy silty CLAY with pebbles and occasional wet sand seams	2					
UL	21			3					
	22			3					
	23								
	24		17'6"						
	25								
F	26		Very stiff moist blue sandy CLAY with pebbles	10					
UL	27			10					
	28			14					
	29		20'6"						
	30								
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TYPE OF SAMPLE
D. - DISTURBED
U.L. - UNDIST. LINER
S.T. - SHELBY TUBE
S.S. - SPLIT SPOON
R.C. - ROCK CORE
() - PENETROMETER

REMARKS:

Standard Penetration Test - Driving 2" OD Sampler 1' With
140# Hammer Falling 30": Count Made at 6" Intervals

GROUND WATER OBSERVATIONS

G.W. ENCOUNTERED AT 6 FT. 3 INS.
G.W. ENCOUNTERED AT 12 FT. 6 INS.
G.W. AFTER COMPLETION 19 FT. 0 INS.
G.W. AFTER HRS. FT. INS.
G.W. VOLUMES light



RTI LABORATORIES, INC.

31628 Glendale St.
Livonia, Michigan 48150
TEL: 734.422.8000
FAX: 734.422.5342
Website: www.rtilab.com

July 26, 2006

Bridget Rohn
Enviro Matrix, Inc.
163 Madison # 104
Detroit, MI 48226-2136

TEL: (313) 964-1550
FAX (313) 964-1770

RE: EDC - 05-008

Order No.: 0604849

Dear Bridget Rohn:

RTI Laboratories, Inc. received 16 sample(s) on 4/27/2006 for the analyses presented in the following report.

There were no problems with the analytical events associated with this report unless noted in the Case Narrative. Quality control data was within laboratory defined or method specified acceptance limits except if noted.

If you have any questions regarding these tests results, please feel free to call.

Sincerely,

A handwritten signature in cursive script, appearing to read "Charles O'Bryan", written in black ink.

Charles O'Bryan
Director, Quality Management

**RTI LABORATORIES, INC.**

31628 Glendale St.
Livonia, Michigan 48150
TEL: 734.422.8000
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Website: www.rtilab.com

Case Narrative

WO#: 0604849
Date: 7/26/2006

CLIENT: Enviro Matrix, Inc.
Project: EDC - 05-008

This report in its entirety consists of the documents listed below. All documents contain the RTI Work Order Number assigned to this report.

1. Paginated Report including: Case Narrative, Analytical Results and Applicable Quality Control Summary Reports.
2. A Cover Letter that immediately precedes the Paginated Report.
3. Paginated copies of the Chain of Custody Documents supplied with this sample set.

Concentrations reported with a J flag in the Qual field are values below the reporting limit (RL) but greater than the established method detection limit (MDL). There is greater uncertainty associated with these results and data should be considered as estimated.

Concentrations reported with an E flag in the Qual field are values that exceed the upper quantification range. There is greater uncertainty associated with these results and data should be considered as estimated.

Any comments or problems with the analytical events associated with this report are noted below.

Elevated reporting limits for several samples due to sample matrix - high concentrations of target and/or non-target analytes present in the sample requiring dilution or volume adjustments at sample preparation.



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Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 1:26:00 PM

Project: EDC - 05-008

Lab ID: 0604849-011

Matrix: SOIL

Client Sample ID 14 @ 4-5.5'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
RCRA METALS - MICHIGAN 10				SW6020A		Analyst: AB2
METALS, ICP/MS						
Arsenic	11,000	240		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Barium	440,000	2,400		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Cadmium	600	480		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Chromium	15,000	4,800		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Copper	99,000	2,400		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Lead	510,000	2,400		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Selenium	630	480		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Silver	300	240		µg/Kg-dry	20	5/1/2006 1:04:19 PM
Zinc	380,000	2,400		µg/Kg-dry	20	5/1/2006 1:04:19 PM
RCRA METALS - MICHIGAN 10				SW7471A		Analyst: AB2
MERCURY						
Mercury	280	18		µg/Kg-dry	1	5/1/2006
POLYNUCLEAR AROMATIC HYDROCARBONS				SW8270C		Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
2-Methylnaphthalene	210	2,400	J	µg/Kg-dry	2	5/5/2006 1:12:00 AM
Acenaphthene	1,700	2,400	J	µg/Kg-dry	2	5/5/2006 1:12:00 AM
Acenaphthylene	ND	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Anthracene	3,000	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Benz(a)anthracene	2,900	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Benzo(a)pyrene	2,400	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Benzo(b)fluoranthene	3,200	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Benzo(g,h,i)perylene	1,400	2,400	J	µg/Kg-dry	2	5/5/2006 1:12:00 AM
Benzo(k)fluoranthene	1,200	2,400	J	µg/Kg-dry	2	5/5/2006 1:12:00 AM
Chrysene	3,900	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Dibenz(a,h)anthracene	ND	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Fluoranthene	9,200	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Fluorene	2,900	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Indeno(1,2,3-cd)pyrene	1,400	2,400	J	µg/Kg-dry	2	5/5/2006 1:12:00 AM
Naphthalene	330	2,400	J	µg/Kg-dry	2	5/5/2006 1:12:00 AM
Phenanthrene	14,000	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Pyrene	7,500	2,400		µg/Kg-dry	2	5/5/2006 1:12:00 AM
Surr: 2,4,6-Tribromophenol	43.7	25-93.9		%REC	2	5/5/2006 1:12:00 AM

Qualifiers: * / X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 1:26:00 PM

Project: EDC - 05-008

Lab ID: 0604849-011

Matrix: SOIL

Client Sample ID 14 @ 4-5.5'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
POLYNUCLEAR AROMATIC HYDROCARBONS						
SEMI-VOLATILE ORGANIC COMPOUNDS					SW8270C	Analyst: JG3
Surr: 2-Fluorobiphenyl	72.0	26-105	%REC		2	5/5/2006 1:12:00 AM
Surr: 2-Fluorophenol	69.4	25-120	%REC		2	5/5/2006 1:12:00 AM
Surr: Nitrobenzene-d5	64.1	30.1-104	%REC		2	5/5/2006 1:12:00 AM
Surr: Phenol-d5	73.7	25-118	%REC		2	5/5/2006 1:12:00 AM
Surr: Terphenyl-d14	67.2	27.1-115	%REC		2	5/5/2006 1:12:00 AM
PERCENT MOISTURE					D2216	Analyst: JW
Percent Moisture	18	1.0	wt%		1	4/28/2006

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 1:36:00 PM

Project: EDC - 05-008

Lab ID: 0604849-012

Matrix: SOIL

Client Sample ID 14 @ 9-10.5'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
RCRA METALS - MICHIGAN 10						Analyst: AB2
METALS, ICP/MS						
Arsenic	7,800	240		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Barium	110,000	2,400		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Cadmium	530	480		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Chromium	16,000	4,800		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Copper	36,000	2,400		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Lead	120,000	2,400		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Selenium	ND	480		µg/Kg-dry	20	5/1/2006 1:06:55 PM
Silver	170	240	J	µg/Kg-dry	20	5/1/2006 1:06:55 PM
Zinc	120,000	2,400		µg/Kg-dry	20	5/1/2006 1:06:55 PM
RCRA METALS - MICHIGAN 10						Analyst: AB2
MERCURY						
Mercury	140	26		µg/Kg-dry	1	5/1/2006
POLYNUCLEAR AROMATIC HYDROCARBONS						Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
2-Methylnaphthalene	37	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Acenaphthene	48	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Acenaphthylene	ND	420		µg/Kg-dry	1	5/5/2006 1:49:00 AM
Anthracene	110	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Benz(a)anthracene	130	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Benzo(a)pyrene	99	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Benzo(b)fluoranthene	140	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Benzo(g,h,i)perylene	51	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Benzo(k)fluoranthene	63	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Chrysene	200	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Dibenz(a,h)anthracene	ND	420		µg/Kg-dry	1	5/5/2006 1:49:00 AM
Fluoranthene	380	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Fluorene	71	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Indeno(1,2,3-cd)pyrene	61	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Naphthalene	77	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Phenanthrene	460	420		µg/Kg-dry	1	5/5/2006 1:49:00 AM
Pyrene	320	420	J	µg/Kg-dry	1	5/5/2006 1:49:00 AM
Surr: 2,4,6-Tribromophenol	60.6	25-93.9		%REC	1	5/5/2006 1:49:00 AM

Qualifiers:

- *X Value exceeds Maximum Contaminant Level
- E Value above quantitation range
- J Analyte detected below quantitation limits
- ND Not Detected at the Reporting Limit
- S Spike Recovery outside accepted recovery limits

- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- M Manual Integration used to determine area response
- RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

31628 Glendale St.
Livonia, Michigan 48150
TEL: 734.422.8000
FAX: 734.422.5342
Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 1:36:00 PM

Project: EDC - 05-008

Lab ID: 0604849-012

Matrix: SOIL

Client Sample ID 14 @ 9-10.5'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
POLYNUCLEAR AROMATIC HYDROCARBONS					SW8270C	Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
Surr: 2-Fluorobiphenyl	53.9	26-105	%REC		1	5/5/2006 1:49:00 AM
Surr: 2-Fluorophenol	52.1	25-120	%REC		1	5/5/2006 1:49:00 AM
Surr: Nitrobenzene-d5	50.8	30.1-104	%REC		1	5/5/2006 1:49:00 AM
Surr: Phenol-d5	56.2	25-118	%REC		1	5/5/2006 1:49:00 AM
Surr: Terphenyl-d14	57.0	27.1-115	%REC		1	5/5/2006 1:49:00 AM
PERCENT MOISTURE					D2216	Analyst: JW
Percent Moisture	21	1.0	wt%		1	4/28/2006

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 2:30:00 PM

Project: EDC - 05-008

Lab ID: 0604849-013

Matrix: SOIL

Client Sample ID 15 @ 1.5-3'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
RCRA METALS - MICHIGAN 10 METALS, ICP/MS		SW6020A			Analyst: AB2	
Arsenic	6,300	210		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Barium	67,000	2,100		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Cadmium	540	420		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Chromium	15,000	4,200		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Copper	82,000	2,100		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Lead	66,000	2,100		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Selenium	850	420		µg/Kg-dry	20	5/1/2006 1:09:32 PM
Silver	74	210	J	µg/Kg-dry	20	5/1/2006 1:09:32 PM
Zinc	110,000	2,100		µg/Kg-dry	20	5/1/2006 1:09:32 PM
RCRA METALS - MICHIGAN 10 MERCURY		SW7471A			Analyst: AB2	
Mercury	170	20		µg/Kg-dry	1	5/1/2006
POLYNUCLEAR AROMATIC HYDROCARBONS SEMI-VOLATILE ORGANIC COMPOUNDS		SW8270C			Analyst: JG3	
2-Methylnaphthalene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Acenaphthene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Acenaphthylene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Anthracene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Benz(a)anthracene	46	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Benzo(a)pyrene	43	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Benzo(b)fluoranthene	61	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Benzo(g,h,i)perylene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Benzo(k)fluoranthene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Chrysene	64	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Dibenz(a,h)anthracene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Fluoranthene	120	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Fluorene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Indeno(1,2,3-cd)pyrene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Naphthalene	ND	370		µg/Kg-dry	1	5/5/2006 2:26:00 AM
Phenanthrene	88	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Pyrene	100	370	J	µg/Kg-dry	1	5/5/2006 2:26:00 AM
Surr: 2,4,6-Tribromophenol	60.1	25-93.9		%REC	1	5/5/2006 2:26:00 AM

Qualifiers: * / X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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TEL: 734.422.8000
FAX: 734.422.5342
Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 2:30:00 PM

Project: EDC - 05-008

Lab ID: 0604849-013

Matrix: SOIL

Client Sample ID 15 @ 1.5-3'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
POLYNUCLEAR AROMATIC HYDROCARBONS				SW8270C		Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
Surr: 2-Fluorobiphenyl	59.8	26-105		%REC	1	5/5/2006 2:26:00 AM
Surr: 2-Fluorophenol	58.5	25-120		%REC	1	5/5/2006 2:26:00 AM
Surr: Nitrobenzene-d5	58.0	30.1-104		%REC	1	5/5/2006 2:26:00 AM
Surr: Phenol-d5	62.7	25-118		%REC	1	5/5/2006 2:26:00 AM
Surr: Terphenyl-d14	57.6	27.1-115		%REC	1	5/5/2006 2:26:00 AM
VOLATILE ORGANIC COMPOUNDS				SW8260B		Analyst: JW
1,1,1,2-Tetrachloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1,1-Trichloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1,2,2-Tetrachloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1,2-Trichloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1-Dichloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1-Dichloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,1-Dichloropropene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2,3-Trichlorobenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2,3-Trichloropropane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2,3-Trimethylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2,4-Trichlorobenzene	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2,4-Trimethylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2-Dibromo-3-chloropropane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2-Dichlorobenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2-Dichloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,2-Dichloropropane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,3,5-Trimethylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,3-Dichlorobenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,3-Dichloropropane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
1,4-Dichlorobenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
2,2-Dichloropropane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
2-Chloroethyl vinyl ether	ND	570		µg/Kg-dry	50	4/28/2006 11:50:00 PM
2-Chlorotoluene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
2-Hexanone	ND	2,800		µg/Kg-dry	50	4/28/2006 11:50:00 PM
2-Methylnaphthalene	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

31628 Glendale St.
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Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 2:30:00 PM

Project: EDC - 05-008

Lab ID: 0604849-013

Matrix: SOIL

Client Sample ID 15 @ 1.5-3'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS				SW8260B		Analyst: JW
2-Nitropropane	ND	230		µg/Kg-dry	50	4/28/2006 11:50:00 PM
4-Chlorotoluene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Acetone	150	2,800	J	µg/Kg-dry	50	4/28/2006 11:50:00 PM
Acrylonitrile	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Benzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Bromobenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Bromochloromethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Bromodichloromethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Bromoform	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Bromomethane	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Carbon disulfide	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Carbon tetrachloride	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Chlorobenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Chloroethane	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Chloroform	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Chloromethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
cis-1,2-Dichloroethene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
cis-1,3-Dichloropropene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Dibromochloromethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Dibromomethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Dichlorodifluoromethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Dichloromethane	32	280	J	µg/Kg-dry	50	4/28/2006 11:50:00 PM
Diethyl ether	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Ethyl methacrylate	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Ethylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Ethylene dibromide	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Hexachlorobutadiene	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Hexachloroethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Isopropyl ether	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Isopropylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
m,p-Xylene	ND	110		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Methyl ethyl ketone	1,800	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Methyl iodide	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Methyl isobutyl ketone	ND	570		µg/Kg-dry	50	4/28/2006 11:50:00 PM

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit



RTI LABORATORIES, INC.

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Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 2:30:00 PM

Project: EDC - 05-008

Lab ID: 0604849-013

Matrix: SOIL

Client Sample ID 15 @ 1.5-3'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS				SW8260B		Analyst: JW
Methyl tert-butyl ether	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Naphthalene	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
n-Butylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
n-Propylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
o-Xylene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
p-Isopropyltoluene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
sec-Butylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Styrene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
t-Butyl alcohol	ND	2,300		µg/Kg-dry	50	4/28/2006 11:50:00 PM
tert-Amyl Methyl Ether	ND	230		µg/Kg-dry	50	4/28/2006 11:50:00 PM
tert-Butyl Ethyl Ether	ND	280		µg/Kg-dry	50	4/28/2006 11:50:00 PM
tert-Butylbenzene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Tetrachloroethene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Toluene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
trans-1,2-Dichloroethene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
trans-1,3-Dichloropropene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
trans-1,4-Dichloro-2-butene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Trichloroethene	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Trichlorofluoromethane	ND	57		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Vinyl chloride	ND	45		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Xylenes, Total	ND	170		µg/Kg-dry	50	4/28/2006 11:50:00 PM
Surr: 4-Bromofluorobenzene	109	70-130		%REC	50	4/28/2006 11:50:00 PM
Surr: Dibromofluoromethane	106	70-130		%REC	50	4/28/2006 11:50:00 PM
Surr: Toluene-d8	114	70-130		%REC	50	4/28/2006 11:50:00 PM
PERCENT MOISTURE				D2216		Analyst: JW
Percent Moisture	12	1.0		wt%	1	4/28/2006

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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Livonia, Michigan 48150
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FAX: 734.422.5342
Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 2:48:00 PM

Project: EDC - 05-008

Lab ID: 0604849-014

Matrix: SOIL

Client Sample ID 16 @ 4-5.5'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
RCRA METALS - MICHIGAN 10				SW6020A		Analyst: AB2
METALS, ICP/MS						
Arsenic	7,500	220		µg/Kg-dry	20	5/1/2006 1:12:08 PM
Barium	55,000	2,200		µg/Kg-dry	20	5/1/2006 1:12:08 PM
Cadmium	450	440		µg/Kg-dry	20	5/1/2006 1:12:08 PM
Chromium	12,000	4,400		µg/Kg-dry	20	5/1/2006 1:12:08 PM
Copper	110,000	2,200		µg/Kg-dry	20	5/1/2006 1:12:08 PM
Lead	57,000	2,200		µg/Kg-dry	20	5/1/2006 1:12:08 PM
Selenium	420	440	J	µg/Kg-dry	20	5/1/2006 1:12:08 PM
Silver	140	220	J	µg/Kg-dry	20	5/1/2006 1:12:08 PM
Zinc	85,000	2,200		µg/Kg-dry	20	5/1/2006 1:12:08 PM
RCRA METALS - MICHIGAN 10				SW7471A		Analyst: AB2
MERCURY						
Mercury	1,100	180		µg/Kg-dry	10	5/1/2006
POLYNUCLEAR AROMATIC HYDROCARBONS				SW8270C		Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
2-Methylnaphthalene	42	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Acenaphthene	ND	390		µg/Kg-dry	1	5/2/2006 4:20:00 PM
Acenaphthylene	ND	390		µg/Kg-dry	1	5/2/2006 4:20:00 PM
Anthracene	38	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Benz(a)anthracene	170	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Benzo(a)pyrene	120	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Benzo(b)fluoranthene	190	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Benzo(g,h,i)perylene	60	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Benzo(k)fluoranthene	ND	390		µg/Kg-dry	1	5/2/2006 4:20:00 PM
Chrysene	160	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Dibenz(a,h)anthracene	ND	390		µg/Kg-dry	1	5/2/2006 4:20:00 PM
Fluoranthene	340	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Fluorene	ND	390		µg/Kg-dry	1	5/2/2006 4:20:00 PM
Indeno(1,2,3-cd)pyrene	57	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Naphthalene	47	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Phenanthrene	220	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Pyrene	260	390	J	µg/Kg-dry	1	5/2/2006 4:20:00 PM
Surr: 2,4,6-Tribromophenol	64.2	25-93.9		%REC	1	5/2/2006 4:20:00 PM

Qualifiers: */X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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TEL: 734.422.8000
FAX: 734.422.5342
Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 2:48:00 PM

Project: EDC - 05-008

Lab ID: 0604849-014

Matrix: SOIL

Client Sample ID 16 @ 4-5.5'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
POLYNUCLEAR AROMATIC HYDROCARBONS		SW8270C				Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
Surr: 2-Fluorobiphenyl	66.7	26-105	%REC		1	5/2/2006 4:20:00 PM
Surr: 2-Fluorophenol	64.4	25-120	%REC		1	5/2/2006 4:20:00 PM
Surr: Nitrobenzene-d5	45.9	30.1-104	%REC		1	5/2/2006 4:20:00 PM
Surr: Phenol-d5	63.4	25-118	%REC		1	5/2/2006 4:20:00 PM
Surr: Terphenyl-d14	87.8	27.1-115	%REC		1	5/2/2006 4:20:00 PM
PERCENT MOISTURE		D2216				Analyst: JW
Percent Moisture	15	1.0	wt%		1	4/28/2006

Qualifiers: * / X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

31628 Glendale St.
Livonia, Michigan 48150
TEL: 734.422.8000
FAX: 734.422.5342
Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 3:14:00 PM

Project: EDC - 05-008

Lab ID: 0604849-015

Matrix: SOIL

Client Sample ID 17 @ 1.5-3'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
RCRA METALS - MICHIGAN 10 METALS, ICP/MS				SW6020A		Analyst: AB2
Arsenic	8,400	240		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Barium	92,000	2,400		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Cadmium	670	470		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Chromium	18,000	4,700		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Copper	68,000	2,400		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Lead	260,000	2,400		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Selenium	640	470		µg/Kg-dry	20	5/1/2006 1:14:44 PM
Silver	130	240	J	µg/Kg-dry	20	5/1/2006 1:14:44 PM
Zinc	130,000	2,400		µg/Kg-dry	20	5/1/2006 1:14:44 PM
RCRA METALS - MICHIGAN 10 MERCURY				SW7471A		Analyst: AB2
Mercury	210	20		µg/Kg-dry	1	5/1/2006
POLYNUCLEAR AROMATIC HYDROCARBONS SEMI-VOLATILE ORGANIC COMPOUNDS				SW8270C		Analyst: JG3
2-Methylnaphthalene	430	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Acenaphthene	440	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Acenaphthylene	550	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Anthracene	1,400	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Benz(a)anthracene	4,000	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Benzo(a)pyrene	2,700	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Benzo(b)fluoranthene	3,900	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Benzo(g,h,i)perylene	1,200	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Benzo(k)fluoranthene	1,500	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Chrysene	3,700	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Dibenz(a,h)anthracene	470	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Fluoranthene	7,700	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Fluorene	1,000	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Indeno(1,2,3-cd)pyrene	1,200	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Naphthalene	330	2,000	J	µg/Kg-dry	2	5/5/2006 7:46:00 PM
Phenanthrene	7,500	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Pyrene	6,800	2,000		µg/Kg-dry	2	5/5/2006 7:46:00 PM
Surr: 2,4,6-Tribromophenol	108	25-93.9	S	%REC	2	5/5/2006 7:46:00 PM

Qualifiers:

- *X Value exceeds Maximum Contaminant Level
- E Value above quantitation range
- J Analyte detected below quantitation limits
- ND Not Detected at the Reporting Limit
- S Spike Recovery outside accepted recovery limits

- B Analyte detected in the associated Method Blank
- H Holding times for preparation or analysis exceeded
- M Manual Integration used to determine area response
- RL Reporting Detection Limit



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Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Project: EDC - 05-008

Lab ID: 0604849-015

Client Sample ID 17 @ 1.5-3'

Collection Date: 4/25/2006 3:14:00 PM

Matrix: SOIL

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
POLYNUCLEAR AROMATIC HYDROCARBONS						Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
Surr: 2-Fluorobiphenyl	242	26-105	S	%REC	2	5/5/2006 7:46:00 PM
Surr: 2-Fluorophenol	203	25-120	S	%REC	2	5/5/2006 7:46:00 PM
Surr: Nitrobenzene-d5	211	30.1-104	S	%REC	2	5/5/2006 7:46:00 PM
Surr: Phenol-d5	234	25-118	S	%REC	2	5/5/2006 7:46:00 PM
Surr: Terphenyl-d14	231	27.1-115	S	%REC	2	5/5/2006 7:46:00 PM
PERCENT MOISTURE						Analyst: JW
Percent Moisture	16	1.0		wt%	1	4/28/2006

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

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Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 3:47:00 PM

Project: EDC - 05-008

Lab ID: 0604849-016

Matrix: SOIL

Client Sample ID 18 @ 6.5-8'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
RCRA METALS - MICHIGAN 10						
METALS, ICP/MS					SW6020A	Analyst: AB2
Arsenic	7,000	240		µg/Kg-dry	20	5/1/2006 1:23:04 PM
Barium	57,000	2,400		µg/Kg-dry	20	5/1/2006 1:23:04 PM
Cadmium	370	470	J	µg/Kg-dry	20	5/1/2006 1:23:04 PM
Chromium	14,000	4,700		µg/Kg-dry	20	5/1/2006 1:23:04 PM
Copper	26,000	2,400		µg/Kg-dry	20	5/1/2006 1:23:04 PM
Lead	85,000	2,400		µg/Kg-dry	20	5/1/2006 1:23:04 PM
Selenium	880	470		µg/Kg-dry	20	5/1/2006 1:23:04 PM
Silver	160	240	J	µg/Kg-dry	20	5/1/2006 1:23:04 PM
Zinc	61,000	2,400		µg/Kg-dry	20	5/1/2006 1:23:04 PM
RCRA METALS - MICHIGAN 10						
MERCURY					SW7471A	Analyst: AB2
Mercury	730	49		µg/Kg-dry	2	5/1/2006
POLYNUCLEAR AROMATIC HYDROCARBONS						
SEMI-VOLATILE ORGANIC COMPOUNDS					SW8270C	Analyst: JG3
2-Methylnaphthalene	ND	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Acenaphthene	720	2,000	J	µg/Kg-dry	5	5/5/2006 8:23:00 PM
Acenaphthylene	610	2,000	J	µg/Kg-dry	5	5/5/2006 8:23:00 PM
Anthracene	2,800	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Benz(a)anthracene	6,600	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Benzo(a)pyrene	5,500	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Benzo(b)fluoranthene	6,800	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Benzo(g,h,i)perylene	2,200	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Benzo(k)fluoranthene	3,200	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Chrysene	6,600	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Dibenz(a,h)anthracene	730	2,000	J	µg/Kg-dry	5	5/5/2006 8:23:00 PM
Fluoranthene	17,000	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Fluorene	1,200	2,000	J	µg/Kg-dry	5	5/5/2006 8:23:00 PM
Indeno(1,2,3-cd)pyrene	2,400	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Naphthalene	480	2,000	J	µg/Kg-dry	5	5/5/2006 8:23:00 PM
Phenanthrene	5,500	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Pyrene	14,000	2,000		µg/Kg-dry	5	5/5/2006 8:23:00 PM
Surr: 2,4,6-Tribromophenol	33.4	25-93.9		%REC	5	5/5/2006 8:23:00 PM

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

**RTI LABORATORIES, INC.**

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Website: www.rtilab.com

Analytical Report

(consolidated)

WO#: 0604849

Date Reported: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Collection Date: 4/25/2006 3:47:00 PM

Project: EDC - 05-008

Lab ID: 0604849-016

Matrix: SOIL

Client Sample ID 18 @ 6.5-8'

Analyses	Result	RL	Qual	Units	DF	Date Analyzed
POLYNUCLEAR AROMATIC HYDROCARBONS				SW8270C		Analyst: JG3
SEMI-VOLATILE ORGANIC COMPOUNDS						
Surr: 2-Fluorobiphenyl	113	26-105	S	%REC	5	5/5/2006 8:23:00 PM
Surr: 2-Fluorophenol	83.0	25-120		%REC	5	5/5/2006 8:23:00 PM
Surr: Nitrobenzene-d5	80.0	30.1-104		%REC	5	5/5/2006 8:23:00 PM
Surr: Phenol-d5	97.4	25-118		%REC	5	5/5/2006 8:23:00 PM
Surr: Terphenyl-d14	115	27.1-115		%REC	5	5/5/2006 8:23:00 PM
PERCENT MOISTURE				D2216		Analyst: JW
Percent Moisture	19	1.0		wt%	1	4/28/2006

Qualifiers: *X Value exceeds Maximum Contaminant Level
E Value above quantitation range
J Analyte detected below quantitation limits
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

B Analyte detected in the associated Method Blank
H Holding times for preparation or analysis exceeded
M Manual Integration used to determine area response
RL Reporting Detection Limit

RTI Laboratories, Inc.

Date: 7/26/2006

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_6020S

Sample ID: 0604849-003B-MS	SampType: MS	TestCode: SW_6020S	Units: µg/Kg-dry	Prep Date: 4/28/2006	RunNo: 5946						
Client ID: 6 @ 14-15.5'	Batch ID: 2816	TestNo: SW6020A		Analysis Date: 5/1/2006	SeqNo: 88299						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	2,300	57,940	0	0	75	125				S
Antimony	ND	700	57,940	0	0	75	125				S
Arsenic	62,000	230	57,940	5,166	98.1	75	125				
Barium	150,000	2,300	57,940	109,200	75.4	75	125				
Beryllium	ND	1,200	57,940	0	0	75	125				S
Boron	ND	12,000	57,940	0	0	75	125				S
Cadmium	61,000	460	57,940	1,772	102	75	125				
Calcium	ND	120,000	579,400	0	0	75	125				S
Chromium	81,000	2,300	57,940	22,870	100	75	125				
Cobalt	ND	1,200	57,940	0	0	75	125				S
Copper	310,000	2,300	57,940	216,500	161	75	125				S
Iron	ND	46,000	57,940	0	0	75	125				S
Lead	57,000	2,300	57,940	24,030	56.5	75	125				S
Magnesium	ND	58,000	579,400	0	0	75	125				S
Manganese	ND	2,300	57,940	0	0	75	125				S
Molybdenum	ND	2,300	57,940	0	0	75	125				S
Nickel	ND	2,300	57,940	0	0	75	125				S
Potassium	ND	46,000	579,400	0	0	75	125				S
Selenium	59,000	460	57,940	874.5	99.6	75	125				
Silicon	ND	120,000	579,400	0	0	75	125				S
Silver	13,000	230	57,940	328.0	22.7	75	125				S
Sodium	ND	70,000	579,400	0	0	75	125				S
Thallium	ND	1,200	57,940	0	0	75	125				S
Titanium	ND	23,000	57,940	0	0	75	125				S
Vanadium	ND	2,300	57,940	0	0	75	125				S
Zinc	220,000	2,300	57,940	216,200	2.53	75	125				S

Qualifiers: E Value above quantitation range
M Manual Integration used to determine area response
RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_6020S

Sample ID: 0604849-003B-MSD		SampType: MSD		TestCode: SW_6020S		Units: µg/Kg-dry		Prep Date: 4/28/2006		RunNo: 5946	
Client ID: 6 @ 14-15.5'		Batch ID: 2816		TestNo: SW6020A				Analysis Date: 5/1/2006		SeqNo: 88300	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	2,400	59,600	0	0	75	125	0	0	25	S
Antimony	ND	720	59,600	0	0	75	125	0	0	25	S
Arsenic	68,000	240	59,600	5,166	106	75	125	62,000	9.61	25	S
Barium	150,000	2,400	59,600	109,200	71.0	75	125	152,900	0.885	25	S
Beryllium	ND	1,200	59,600	0	0	75	125	0	0	25	S
Boron	ND	12,000	59,600	0	0	75	125	0	0	25	S
Cadmium	68,000	480	59,600	1,772	110	75	125	61,110	9.95	25	S
Calcium	ND	120,000	596,000	0	0	75	125	0	0	25	S
Chromium	85,000	2,400	59,600	22,870	105	75	125	81,000	5.19	25	S
Cobalt	ND	1,200	59,600	0	0	75	125	0	0	25	S
Copper	400,000	2,400	59,600	216,500	303	75	125	309,600	24.8	25	S
Iron	ND	48,000	59,600	0	0	75	125	0	0	25	S
Lead	65,000	2,400	59,600	24,030	69.3	75	125	56,740	14.1	25	S
Magnesium	ND	60,000	596,000	0	0	75	125	0	0	25	S
Manganese	ND	2,400	59,600	0	0	75	125	0	0	25	S
Molybdenum	ND	2,400	59,600	0	0	75	125	0	0	25	S
Nickel	ND	2,400	59,600	0	0	75	125	0	0	25	S
Potassium	ND	48,000	596,000	0	0	75	125	0	0	25	S
Selenium	65,000	480	59,600	874.5	108	75	125	58,580	10.4	25	S
Silicon	ND	120,000	596,000	0	0	75	125	0	0	25	S
Silver	12,000	240	59,600	328.0	18.9	75	125	13,490	15.2	25	S
Sodium	ND	72,000	596,000	0	0	75	125	0	0	25	S
Thallium	ND	1,200	59,600	0	0	75	125	0	0	25	S
Titanium	ND	24,000	59,600	0	0	75	125	0	0	25	S
Vanadium	ND	2,400	59,600	0	0	75	125	0	0	25	S
Zinc	250,000	2,400	59,600	216,200	53.7	75	125	217,700	13.1	25	S

Sample ID: LCS-2816	SampType: LCS	TestCode: SW_6020S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5946						
Client ID: LCSS	Batch ID: 2816	TestNo: SW6020A		Analysis Date: 5/1/2006	SeqNo: 88357						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Qualifiers: E Value above quantitation range H Holding times for preparation or analysis exceeded J Analyte detected below quantitation limit
 M Manual Integration used to determine area response ND Not Detected at the Reporting Limit R RPD outside accepted recovery limits
 RL Reporting Detection Limit S Spike Recovery outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_6020S

Sample ID: LCS-2816	SampType: LCS	TestCode: SW_6020S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5946						
Client ID: LCSS	Batch ID: 2816	TestNo: SW6020A		Analysis Date: 5/1/2006	SeqNo: 88357						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	980	4.0	1,000	0	97.7	80	120				
Barium	1,000	40	1,000	0	99.6	80	120				
Cadmium	1,000	8.0	1,000	0	102	80	120				
Chromium	990	40	1,000	0	99.4	80	120				
Copper	1,000	40	1,000	0	101	80	120				
Lead	1,000	40	1,000	0	100	80	120				
Selenium	1,000	8.0	1,000	0	102	80	120				
Silver	1,000	4.0	1,000	0	101	80	120				
Zinc	1,000	40	1,000	0	103	80	120				

Zinc

Sample ID: MB-2816	SampType: MBLK	TestCode: SW_6020S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5946						
Client ID: PBS	Batch ID: 2816	TestNo: SW6020A		Analysis Date: 5/1/2006	SeqNo: 88359						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Arsenic	0.56	0.20									
Barium	0.55	2.0									J
Cadmium	0.71	0.40									
Chromium	0.46	2.0									J
Copper	0.78	2.0									J
Lead	0.72	2.0									J
Selenium	0.35	0.40									
Silver	0.33	0.20									
Zinc	3.3	2.0									

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_7471S

Sample ID: 0604849-008B-MS		SampType: MS	TestCode: SW_7471S		Units: µg/Kg-dry	Prep Date: 5/1/2006		RunNo: 5960			
Client ID: 11 @ 4.5'		Batch ID: 2831	TestNo: SW7471A			Analysis Date: 5/1/2006		SeqNo: 88476			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	280	26	255.3	57.05	86.2	80	120				

Sample ID: 0604849-008B-MSD		SampType: MSD	TestCode: SW_7471S		Units: µg/Kg-dry	Prep Date: 5/1/2006		RunNo: 5960			
Client ID: 11 @ 4.5'		Batch ID: 2831	TestNo: SW7471A			Analysis Date: 5/1/2006		SeqNo: 88477			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	230	22	218.8	57.05	78.4	80	120	277.0	19.1	25	S

Sample ID: 0604849-016B-MS		SampType: MS	TestCode: SW_7471S		Units: µg/Kg-dry	Prep Date: 5/1/2006		RunNo: 5960			
Client ID: 18 @ 6.5-8'		Batch ID: 2831	TestNo: SW7471A			Analysis Date: 5/1/2006		SeqNo: 88490			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	1,300	24	236.5	725.7	251	80	120				S

Sample ID: 0604849-016B-MSD		SampType: MSD	TestCode: SW_7471S		Units: µg/Kg-dry	Prep Date: 5/1/2006		RunNo: 5960			
Client ID: 18 @ 6.5-8'		Batch ID: 2831	TestNo: SW7471A			Analysis Date: 5/1/2006		SeqNo: 88491			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	560	24	236.5	725.7	-68.8	80	120	1,319	80.3	25	SR

Qualifiers:
 E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604849-001A	SampType: MS	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5947						
Client ID: 6 @ 4-5.5'	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88127						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	570	63	633.7	0	90.3	70	130				
1,1,1-Trichloroethane	620	63	633.7	0	97.5	70	130				
1,1,2,2-Tetrachloroethane	590	63	633.7	0	93.3	70	130				
1,1,2-Trichloro-1,2,2-trifluoroethane	710	63	633.7	0	112	70	130				
1,1,2-Trichloroethane	600	63	633.7	0	94.2	70	130				
1,1-Dichloroethane	640	63	633.7	0	101	70	130				
1,1-Dichloroethene	630	63	633.7	0	100	70	130				
1,1-Dichloropropene	660	63	633.7	0	104	70	130				
1,2,3-Trichlorobenzene	640	63	633.7	0	100	70	130				
1,2,3-Trichloropropane	570	63	633.7	0	90.2	70	130				
1,2,3-Trimethylbenzene	640	63	633.7	41.19	94.5	70	130				
1,2,4-Trichlorobenzene	650	320	633.7	0	102	70	130				
1,2,4-Trimethylbenzene	710	63	633.7	65.27	102	70	130				
1,2-Dibromo-3-chloropropane	520	63	633.7	0	82.7	70	130				
1,2-Dichlorobenzene	670	63	633.7	0	105	70	130				
1,2-Dichloroethane	670	63	633.7	0	106	70	130				
1,2-Dichloropropane	630	63	633.7	0	99.7	70	130				
1,3,5-Trimethylbenzene	680	63	633.7	24.71	103	70	130				
1,3-Dichlorobenzene	630	63	633.7	0	99.3	70	130				
1,3-Dichloropropane	610	63	633.7	0	95.9	70	130				
1,4-Dichlorobenzene	690	63	633.7	0	109	70	130				
2,2-Dichloropropane	930	63	633.7	0	147	70	130				S
2-Chloroethyl vinyl ether	480	630	633.7	0	75.1	70	130				J
2-Chlorotoluene	680	63	633.7	0	107	70	130				
2-Hexanone	920	3,200	633.7	0	146	70	130				JS
2-Methylnaphthalene	790	320	633.7	275.0	81.5	70	130				
2-Nitropropane	450	250	633.7	0	71.5	70	130				
4-Chlorotoluene	660	63	633.7	0	105	70	130				
Acetone	1,600	3,200	633.7	0	245	70	130				JS
Acrylonitrile	570	320	633.7	0	90.3	70	130				
Benzene	670	63	633.7	0	107	70	130				

Qualifiers: E Value above quantitation range
M Manual Integration used to determine area response
RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604849-001A		SampType: MS	TestCode: SW_8260S		Units: µg/Kg-dry	Prep Date:		RunNo: 5947			
Client ID: 6 @ 4-5.5'		Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006		SeqNo: 88127				
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Bromobenzene	610	63	633.7	0	97.0	30	1000	100			
Bromochloromethane	...										

Bromobenzene	610	63	633.7	0	97.0	70	130				
Bromochloromethane	650	63	633.7	0	103	70	130				
Bromodichloromethane	520	63	633.7	0	82.2	70	130				
Bromoform	440	63	633.7	0	70.0	70	130				
Bromomethane	710	320	633.7	0	111	70	130				
Carbon disulfide	670	320	633.7	0	106	70	130				
Carbon tetrachloride	630	63	633.7	0	99.2	70	130				
Chlorobenzene	650	63	633.7	0	102	70	130				
Chloroethane	740	320	633.7	0	116	70	130				
Chloroform	630	63	633.7	0	99.5	70	130				
Chloromethane	600	63	633.7	0	94.7	70	130				
cis-1,2-Dichloroethene	690	63	633.7	0	109	70	130				
cis-1,3-Dichloropropene	620	63	633.7	0	97.5	70	130				
Dibromochloromethane	520	63	633.7	0	81.6	70	130				
Dibromomethane	630	63	633.7	0	99.9	70	130				
Dichlorodifluoromethane	590	63	633.7	0	92.7	70	130				
Dichloromethane	670	320	633.7	0	105	70	130				
Diethyl ether	660	320	633.7	0	105	70	130				
Ethyl methacrylate	560	63	633.7	0	88.6	70	130				
Ethylbenzene	650	63	633.7	25.98	98.9	70	130				
Ethylene dibromide	590	63	633.7	0	92.6	70	130				
Hexachlorobutadiene	790	320	633.7	0	124	70	130				
Hexachloroethane	500	63	633.7	0	79.4	70	130				
Isopropyl ether	670	320	633.7	0	107	70	130				
Isopropylbenzene	710	63	633.7	0	112	70	130				
m,p-Xylene	1,400	130	1,267	92.52	99.3	70	130				
Methyl ethyl ketone	1,100	320	633.7	0	179	70	130				
Methyl iodide	550	320	633.7	0	86.3	70	130				S
Methyl isobutyl ketone	570	630	633.7	0	89.7	70	130				
Methyl tert-butyl ether	1,200	320	1,267	0	94.2	70	130				J
Naphthalene	960	320	633.7	298.5	104	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604849-001A	SampType: MS	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5947						
Client ID: 6 @ 4-5.5'	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88127						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
n-Butylbenzene	740	63	633.7	33.59	112	70	130				
n-Propylbenzene	700	63	633.7	21.55	108	70	130				
o-Xylene	660	63	633.7	49.43	96.9	70	130				
p-Isopropyltoluene	690	63	633.7	0	109	70	130				
sec-Butylbenzene	690	63	633.7	0	109	70	130				
Styrene	650	63	633.7	0	103	70	130				
t-Butyl alcohol	2,700	2,500	3,168	0	85.9	70	130				
tert-Amyl Methyl Ether	620	250	633.7	0	98.3	70	130				
tert-Butyl Ethyl Ether	630	320	633.7	0	99.1	70	130				
tert-Butylbenzene	650	63	633.7	0	103	70	130				
Tetrachloroethene	720	63	633.7	0	113	70	130				
Toluene	670	63	633.7	67.80	94.3	70	130				
trans-1,2-Dichloroethene	640	63	633.7	0	101	70	130				
trans-1,3-Dichloropropene	590	63	633.7	0	93.4	70	130				
trans-1,4-Dichloro-2-butene	560	63	633.7	0	88.4	70	130				
Trichloroethene	650	63	633.7	31.05	98.3	70	130				
Trichlorofluoromethane	690	63	633.7	0	109	70	130				
Vinyl chloride	670	51	633.7	0	105	70	130				
Xylenes, Total	2,000	190	1,901	141.9	98.5	70	130				
Surr: 4-Bromofluorobenzene	3,600		3,168		113	70	130				
Surr: Dibromofluoromethane	3,500		3,168		110	70	130				
Surr: Toluene-d8	3,300		3,168		104	70	130				

Sample ID: 0604849-001A		SampType: MSD	TestCode: SW_8260S		Units: µg/Kg-dry	Prep Date:			RunNo: 5947		
Client ID: 6 @ 4-5.5'		Batch ID: R5947	TestNo: SW8260B			Analysis Date: 4/28/2006			SeqNo: 88128		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	590	63	633.7	0	93.6	70	130	572.2	3.59	25	
1,1,1-Trichloroethane	610	63	633.7	0	95.6	70	130	617.8	1.97	25	
1,1,2,2-Tetrachloroethane	600	63	633.7	0	94.6	70	130	591.2	1.38	25	
1,1,2-Trichloro-1,2,2-trifluoroethane	730	63	633.7	0	115	70	130	707.2	2.57	25	

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604849-001A

SampType: MSD

TestCode: SW_8260S

Units: µg/Kg-dry

Prep Date:

RunNo: 5947

Client ID: 6 @ 4-5.5'

Batch ID: R5947

TestNo: SW8260B

Analysis Date: 4/28/2006

SeqNo: 88128

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,2-Trichloroethane	600	63	633.7	0	94.9	70	130	596.9	0.740	25	
1,1-Dichloroethane	640	63	633.7	0	101	70	130	639.4	0.397	25	
1,1-Dichloroethene	640	63	633.7	0	102	70	130	633.7	1.49	25	
1,1-Dichloropropene	690	63	633.7	0	108	70	130	657.8	4.15	25	
1,2,3-Trichlorobenzene	620	63	633.7	0	98.4	70	130	635.6	1.91	25	
1,2,3-Trichloropropane	560	63	633.7	0	88.4	70	130	571.6	2.02	25	
1,2,3-Trimethylbenzene	640	63	633.7	41.19	93.8	70	130	640.0	0.695	25	
1,2,4-Trichlorobenzene	680	320	633.7	0	107	70	130	646.4	4.78	25	
1,2,4-Trimethylbenzene	710	63	633.7	65.27	102	70	130	714.2	0.802	25	
1,2-Dibromo-3-chloropropane	530	63	633.7	0	83.3	70	130	524.1	0.723	25	
1,2-Dichlorobenzene	660	63	633.7	0	103	70	130	666.6	1.73	25	
1,2-Dichloroethane	670	63	633.7	0	106	70	130	668.5	0.473	25	
1,2-Dichloropropane	620	63	633.7	0	98.1	70	130	631.8	1.62	25	
1,3,5-Trimethylbenzene	670	63	633.7	24.71	102	70	130	676.1	0.564	25	
1,3-Dichlorobenzene	640	63	633.7	0	102	70	130	629.3	2.39	25	
1,3-Dichloropropane	610	63	633.7	0	97.0	70	130	607.7	1.14	25	
1,4-Dichlorobenzene	680	63	633.7	0	108	70	130	688.2	0.832	25	
2,2-Dichloropropane	910	63	633.7	0	144	70	130	930.9	1.79	25	S
2-Chloroethyl vinyl ether	490	630	633.7	0	77.5	70	130	475.9	0	25	J
2-Chlorotoluene	630	63	633.7	0	99.2	70	130	679.3	7.75	25	
2-Hexanone	930	3,200	633.7	0	147	70	130	923.9	0	25	JS
2-Methylnaphthalene	870	320	633.7	275.0	93.8	70	130	791.5	9.39	25	
2-Nitropropane	490	250	4,436	0	11.0	70	130	453.1	7.02	0	S
4-Chlorotoluene	650	63	633.7	0	103	70	130	662.8	2.03	25	
Acetone	1,500	3,200	633.7	0	238	70	130	1,554	0	25	JS
Acrylonitrile	590	320	633.7	0	93.6	70	130	572.2	3.59	25	
Benzene	660	63	633.7	0	105	70	130	674.9	1.90	25	
Bromobenzene	630	63	633.7	0	99.7	70	130	614.7	2.75	25	
Bromochloromethane	650	63	633.7	0	103	70	130	651.4	0.291	25	
Bromodichloromethane	520	63	633.7	0	82.6	70	130	520.9	0.485	25	
Bromoform	470	63	633.7	0	74.1	70	130	443.6	5.69	25	

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604849-001A	SampType: MSD	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5947						
Client ID: 6 @ 4-5.5'	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88128						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Bromomethane	670	320	633.7	0	106	70	130	705.9	5.44	25	
Carbon disulfide	670	320	633.7	0	105	70	130	671.7	0.663	25	
Carbon tetrachloride	610	63	633.7	0	95.5	70	130	628.6	3.80	25	
Chlorobenzene	660	63	633.7	0	105	70	130	648.3	2.51	25	
Chloroethane	700	320	633.7	0	111	70	130	737.6	4.93	25	
Chloroform	630	63	633.7	0	99.2	70	130	630.5	0.302	25	
Chloromethane	600	63	633.7	0	94.2	70	130	600.1	0.529	25	
cis-1,2-Dichloroethene	590	63	633.7	0	93.1	70	130	692.6	16.0	25	
cis-1,3-Dichloropropene	640	63	633.7	0	100	70	130	617.8	2.93	25	
Dibromochloromethane	530	63	633.7	0	84.3	70	130	517.1	3.25	25	
Dibromomethane	600	63	633.7	0	95.0	70	130	633.1	5.03	25	
Dichlorodifluoromethane	580	63	633.7	0	91.6	70	130	587.4	1.19	25	
Dichloromethane	620	320	633.7	0	97.3	70	130	666.6	7.80	25	
Diethyl ether	630	320	633.7	0	99.1	70	130	664.1	5.59	25	
Ethyl methacrylate	550	63	633.7	0	86.7	70	130	561.4	2.17	25	
Ethylbenzene	660	63	633.7	25.98	100	70	130	652.7	1.16	25	
Ethylene dibromide	630	63	633.7	0	99.6	70	130	586.8	7.28	25	
Hexachlorobutadiene	800	320	633.7	0	126	70	130	785.1	1.84	25	
Hexachloroethane	520	63	633.7	0	82.6	70	130	503.1	3.95	25	
Isopropyl ether	650	320	633.7	0	103	70	130	674.9	3.83	25	
Isopropylbenzene	700	63	633.7	0	110	70	130	710.4	1.89	25	
m,p-Xylene	1,300	130	1,267	92.52	98.1	70	130	1,350	1.09	25	
Methyl ethyl ketone	1,100	320	633.7	0	177	70	130	1,137	1.57	25	S
Methyl Iodide	570	320	633.7	0	89.8	70	130	546.9	3.98	25	
Methyl isobutyl ketone	610	630	633.7	0	96.9	70	130	568.4	0	25	J
Methyl tert-butyl ether	1,200	320	1,267	0	92.7	70	130	1,194	1.66	25	
Naphthalene	910	320	633.7	298.5	95.9	70	130	959.4	5.71	25	
n-Butylbenzene	710	63	633.7	33.59	107	70	130	743.3	4.36	25	
n-Propylbenzene	680	63	633.7	21.55	104	70	130	702.8	3.02	25	
o-Xylene	670	63	633.7	49.43	98.6	70	130	663.5	1.61	25	
p-Isopropyltoluene	700	63	633.7	0	111	70	130	687.6	2.19	25	

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

TestCode: SW_8260S

Sample ID: 0604849-001A	SampType: MSD	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5947						
Client ID: 6 @ 4-5.5'	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88128						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
sec-Butylbenzene	690	63	633.7	0	109	70	130	693.3	0	25	
Styrene	670	63	633.7	0	106	70	130	654.6	2.11	25	
t-Butyl alcohol	2,800	2,500	3,168	0	89.0	70	130	2,722	3.54	25	
tert-Amyl Methyl Ether	620	250	633.7	0	97.3	70	130	622.9	1.02	25	
tert-Butyl Ethyl Ether	620	320	633.7	0	98.4	70	130	628.0	0.709	25	
tert-Butylbenzene	660	63	633.7	0	105	70	130	652.7	1.54	25	
Tetrachloroethene	730	63	633.7	0	115	70	130	716.1	1.41	25	
Toluene	700	63	633.7	67.80	100	70	130	665.4	5.56	25	
trans-1,2-Dichloroethene	650	63	633.7	0	102	70	130	642.6	0.981	25	
trans-1,3-Dichloropropene	580	63	633.7	0	92.2	70	130	591.9	1.29	25	
trans-1,4-Dichloro-2-butene	610	63	633.7	0	96.6	70	130	560.2	8.86	25	
Trichloroethene	650	63	633.7	31.05	98.0	70	130	654.0	0.291	25	
Trichlorofluoromethane	630	63	633.7	0	99.1	70	130	688.2	9.15	25	
Vinyl chloride	670	51	633.7	0	106	70	130	667.3	0.945	25	
Xylenes, Total	2,000	190	1,901	141.9	98.3	70	130	2,014	0.189	25	
Surr: 4-Bromofluorobenzene	3,600		3,168		112	70	130		0	25	
Surr: Dibromofluoromethane	3,400		3,168		109	70	130		0	25	
Surr: Toluene-d8	3,500		3,168		112	70	130		0	25	

Sample ID: 10-ug/L 1-284

Sample ID: 10ug/L LCS1		SampType: LCS	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947					
Client ID: LCSS		Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88136					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	490	50	500.0	0	97.5	70	130				
1,1,1-Trichloroethane	500	50	500.0	0	100	70	130				
1,1,2,2-Tetrachloroethane	500	50	500.0	0	100	70	130				
1,1,2-Trichloro-1,2,2-trifluoroethane	610	50	500.0	0	122	70	130				
1,1,2-Trichloroethane	540	50	500.0	0	107	70	130				
1,1-Dichloroethane	530	50	500.0	0	106	70	130				
1,1-Dichloroethene	520	50	500.0	0	104	70	130				
1,1-Dichloropropene	550	50	500.0	0	111	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit
 H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 10ug/L LCS1		SampType: LCS	TestCode: SW_8260S		Units: µg/Kg	Prep Date:			RunNo: 5947		
Client ID: LCSS		Batch ID: R5947	TestNo: SW8260B			Analysis Date: 4/28/2006			SeqNo: 88136		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,3-Trichlorobenzene	630	50	500.0	0	125	70	130				
1,2,3-Trichloropropane	480	50	500.0	0	96.0	70	130				
1,2,3-Trimethylbenzene	500	50	500.0	0	101	70	130				
1,2,4-Trichlorobenzene	590	250	500.0	0	118	70	130				
1,2,4-Trimethylbenzene	530	50	500.0	0	107	70	130				
1,2-Dibromo-3-chloropropane	500	50	500.0	0	99.7	70	130				
1,2-Dichlorobenzene	550	50	500.0	0	110	70	130				
1,2-Dichloroethane	540	50	500.0	0	109	70	130				
1,2-Dichloropropane	520	50	500.0	0	104	70	130				
1,3,5-Trimethylbenzene	520	50	500.0	0	105	70	130				
1,3-Dichlorobenzene	510	50	500.0	0	102	70	130				
1,3-Dichloropropane	530	50	500.0	0	107	70	130				
1,4-Dichlorobenzene	590	50	500.0	0	118	70	130				
2,2-Dichloropropane	780	50	500.0	0	156	70	130				S
2-Chloroethyl vinyl ether	480	500	500.0	0	95.3	70	130				J
2-Chlorotoluene	550	50	500.0	0	110	70	130				
2-Hexanone	650	2,500	500.0	0	130	70	130				J
2-Methylnaphthalene	810	250	500.0	0	161	70	130				S
2-Nitropropane	360	200	500.0	0	73.0	70	130				
4-Chlorotoluene	540	50	500.0	0	108	70	130				
Acetone	1,100	2,500	500.0	0	212	70	130				JS
Acrylonitrile	530	250	500.0	0	106	70	130				
Benzene	530	50	500.0	0	105	70	130				
Bromobenzene	500	50	500.0	0	101	70	130				
Bromochloromethane	570	50	500.0	0	113	70	130				
Bromodichloromethane	450	50	500.0	0	89.6	70	130				
Bromoform	390	50	500.0	0	77.6	70	130				
Bromomethane	470	250	500.0	0	94.2	70	130				
Carbon disulfide	550	250	500.0	0	111	70	130				
Carbon tetrachloride	500	50	500.0	0	100	70	130				
Chlorobenzene	530	50	500.0	0	107	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 10ug/L LCS1	SampType: LCS	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947						
Client ID: LCSS	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88136						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloroethane	560	250	500.0	0	112	70	130				
Chloroform	510	50	500.0	0	102	70	130				
Chloromethane	510	50	500.0	0	101	70	130				
cis-1,2-Dichloroethene	490	50	500.0	0	98.5	70	130				
cis-1,3-Dichloropropene	550	50	500.0	0	110	70	130				
Dibromochloromethane	460	50	500.0	0	92.7	70	130				
Dibromomethane	520	50	500.0	0	105	70	130				
Dichlorodifluoromethane	500	50	500.0	0	99.4	70	130				
Dichloromethane	540	250	500.0	0	109	70	130				
Diethyl ether	560	250	500.0	0	112	70	130				
Ethyl methacrylate	510	50	500.0	0	101	70	130				
Ethylbenzene	520	50	500.0	0	105	70	130				
Ethylene dibromide	550	50	500.0	0	110	70	130				
Hexachlorobutadiene	620	250	500.0	0	125	70	130				
Hexachloroethane	430	50	500.0	0	85.9	70	130				
Isopropyl ether	560	250	500.0	0	111	70	130				
Isopropylbenzene	560	50	500.0	0	112	70	130				
m,p-Xylene	1,000	100	1,000	0	103	70	130				
Methyl ethyl ketone	820	250	500.0	0	165	70	130				
Methyl Iodide	450	250	500.0	0	89.3	70	130				S
Methyl isobutyl ketone	530	500	500.0	0	106	70	130				
Methyl tert-butyl ether	1,000	250	1,000	0	104	70	130				
Naphthalene	600	250	500.0	0	120	70	130				
n-Butylbenzene	590	50	500.0	0	118	70	130				
n-Propylbenzene	550	50	500.0	0	109	70	130				
o-Xylene	500	50	500.0	0	99.9	70	130				
p-Isopropyltoluene	540	50	500.0	0	108	70	130				
sec-Butylbenzene	550	50	500.0	0	110	70	130				
Styrene	530	50	500.0	0	106	70	130				
t-Butyl alcohol	2,500	2,000	2,500	0	101	70	130				
tert-Amyl Methyl Ether	510	200	500.0	0	103	70	130				

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limit
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 10ug/L LCS1	SampType: LCS	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947						
Client ID: LCSS	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88136						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
tert-Butyl Ethyl Ether	520	250	500.0	0	104	70	130				
tert-Butylbenzene	550	50	500.0	0	110	70	130				
Tetrachloroethene	530	50	500.0	0	105	70	130				
Toluene	570	50	500.0	0	114	70	130				
trans-1,2-Dichloroethene	550	50	500.0	0	111	70	130				
trans-1,3-Dichloropropene	530	50	500.0	0	106	70	130				
trans-1,4-Dichloro-2-butene	420	50	500.0	0	84.6	70	130				
Trichloroethene	530	50	500.0	0	106	70	130				
Trichlorofluoromethane	560	50	500.0	0	111	70	130				
Vinyl chloride	570	40	500.0	0	113	70	130				
Xylenes, Total	1,500	150	1,500	0	102	70	130				
Surr: 4-Bromofluorobenzene	2,700		2,500		109	70	130				
Surr: Dibromofluoromethane	2,700		2,500		106	70	130				
Surr: Toluene-d8	2,900		2,500		114	70	130				

Sample ID: MBLK1 1.0mL	SampType: MBLK	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947						
Client ID: PBS	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88137						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	50									
1,1,1-Trichloroethane	ND	50									
1,1,2,2-Tetrachloroethane	ND	50									
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	50									
1,1,2-Trichloroethane	ND	50									
1,1-Dichloroethane	ND	50									
1,1-Dichloroethene	ND	50									
1,1-Dichloropropene	ND	50									
1,2,3-Trichlorobenzene	ND	50									
1,2,3-Trichloropropane	ND	50									
1,2,3-Trimethylbenzene	ND	50									
1,2,4-Trichlorobenzene	ND	250									

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: MBLK1 1.0mL	SampType: MBLK	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947						
Client ID: PBS	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88137						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trimethylbenzene	ND	50									
1,2-Dibromo-3-chloropropane	ND	50									
1,2-Dichlorobenzene	ND	50									
1,2-Dichloroethane	ND	50									
1,2-Dichloropropane	ND	50									
1,3,5-Trimethylbenzene	ND	50									
1,3-Dichlorobenzene	ND	50									
1,3-Dichloropropane	ND	50									
1,4-Dichlorobenzene	ND	50									
2,2-Dichloropropane	ND	50									
2-Chloroethyl vinyl ether	ND	500									
2-Chlorotoluene	ND	50									
2-Hexanone	ND	2,500									
2-Methylnaphthalene	ND	250									
2-Nitropropane	ND	200									
4-Chlorotoluene	ND	50									
Acetone	160	2,500									
Acrylonitrile	ND	250									J
Benzene	ND	50									
Bromobenzene	ND	50									
Bromochloromethane	ND	50									
Bromodichloromethane	ND	50									
Bromoform	ND	50									
Bromomethane	ND	250									
Carbon disulfide	ND	250									
Carbon tetrachloride	ND	50									
Chlorobenzene	ND	50									
Chloroethane	ND	250									
Chloroform	ND	50									
Chloromethane	ND	50									
cis-1,2-Dichloroethene	ND	50									

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: MBLK1 1.0mL	SampType: MBLK	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947						
Client ID: PBS	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88137						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
cis-1,3-Dichloropropene	ND	50									
Dibromochloromethane	ND	50									
Dibromomethane	ND	50									
Dichlorodifluoromethane	ND	50									
Dichloromethane	75	250									J
Diethyl ether	ND	250									
Ethyl methacrylate	ND	50									
Ethylbenzene	ND	50									
Ethylene dibromide	ND	50									
Hexachlorobutadiene	ND	250									
Hexachloroethane	ND	50									
Isopropyl ether	ND	250									
Isopropylbenzene	ND	50									
m,p-Xylene	ND	100									
Methyl ethyl ketone	ND	250									
Methyl Iodide	ND	250									
Methyl isobutyl ketone	ND	500									
Methyl tert-butyl ether	ND	250									
Naphthalene	ND	250									
n-Butylbenzene	ND	50									
n-Propylbenzene	ND	50									
o-Xylene	ND	50									
p-Isopropyltoluene	ND	50									
sec-Butylbenzene	ND	50									
Styrene	ND	50									
t-Butyl alcohol	ND	2,000									
tert-Amyl Methyl Ether	ND	200									
tert-Butyl Ethyl Ether	ND	250									
tert-Butylbenzene	ND	50									
Tetrachloroethene	ND	50									
Toluene	ND	50									

Qualifiers:	E Value above quantitation range	H Holding times for preparation or analysis exceeded	J Analyte detected below quantitation lin
	M Manual Integration used to determine area response	ND Not Detected at the Reporting Limit	R RPD outside accepted recovery limits
	RL Reporting Detection Limit	S Spike Recovery outside accepted recovery limits	

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: MBLK1 1.0mL	SampType: MBLK	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5947						
Client ID: PBS	Batch ID: R5947	TestNo: SW8260B		Analysis Date: 4/28/2006	SeqNo: 88137						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
trans-1,2-Dichloroethene	ND	50									
trans-1,3-Dichloropropene	ND	50									
trans-1,4-Dichloro-2-butene	ND	50									
Trichloroethene	ND	50									
Trichlorofluoromethane	ND	50									
Vinyl chloride	ND	40									
Xylenes, Total	ND	150									
Surr: 4-Bromofluorobenzene	2,700		2,500		109	70	130				
Surr: Dibromofluoromethane	2,700		2,500		107	70	130				
Surr: Toluene-d8	2,600		2,500		105	70	130				

Sample ID: 0604884-001A	SampType: MS	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5970						
Client ID: ZZZZZZ	Batch ID: R5970	TestNo: SW8260B		Analysis Date: 5/1/2006	SeqNo: 88569						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	490	56	562.9	0	87.3	70	130				
1,1,1-Trichloroethane	550	56	562.9	0	97.1	70	130				
1,1,2,2-Tetrachloroethane	520	56	562.9	0	92.2	70	130				
1,1,2-Trichloro-1,2,2-trifluoroethane	600	56	562.9	0	107	70	130				
1,1,2-Trichloroethane	540	56	562.9	0	95.4	70	130				
1,1-Dichloroethane	560	56	562.9	0	99.0	70	130				
1,1-Dichloroethene	540	56	562.9	0	96.1	70	130				
1,1-Dichloropropene	570	56	562.9	0	101	70	130				
1,2,3-Trichlorobenzene	510	56	562.9	0	91.3	70	130				
1,2,3-Trichloropropane	560	56	562.9	0	98.7	70	130				
1,2,3-Trimethylbenzene	510	56	562.9	0	89.9	70	130				
1,2,4-Trichlorobenzene	520	280	562.9	0	92.0	70	130				
1,2,4-Trimethylbenzene	530	56	562.9	0	93.8	70	130				
1,2-Dibromo-3-chloropropane	460	56	562.9	0	82.4	70	130				
1,2-Dichlorobenzene	540	56	562.9	0	96.6	70	130				
1,2-Dichloroethane	600	56	562.9	0	107	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit
 H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits
 J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604884-001A		SampType: MS	TestCode: SW_8260S		Units: µg/Kg-dry	Prep Date:			RunNo: 5970		
Client ID: ZZZZZZ		Batch ID: R6970	TestNo: SW8260B			Analysis Date: 5/1/2006			SeqNo: 88569		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2-Dichloropropane	560	56	562.9	0	99.3	70	130				
1,3,5-Trimethylbenzene	530	56	562.9	0	93.9	70	130				
1,3-Dichlorobenzene	520	56	562.9	0	91.6	70	130				
1,3-Dichloropropane	560	56	562.9	0	98.9	70	130				
1,4-Dichlorobenzene	540	56	562.9	0	95.6	70	130				
2,2-Dichloropropane	770	56	562.9	0	137	70	130				S
2-Chloroethyl vinyl ether	430	560	562.9	0	77.0	70	130				J
2-Chlorotoluene	520	56	562.9	0	93.1	70	130				
2-Hexanone	820	2,800	562.9	0	145	70	130				JS
2-Methylnaphthalene	460	280	562.9	0	81.9	70	130				
2-Nitropropane	470	230	562.9	0	84.2	70	130				
4-Chlorotoluene	510	56	562.9	0	90.9	70	130				
Acetone	1,500	2,800	562.9	0	273	70	130				JS
Acrylonitrile	580	280	562.9	0	104	70	130				
Benzene	580	56	562.9	0	103	70	130				
Bromobenzene	530	56	562.9	0	94.3	70	130				
Bromochloromethane	580	56	562.9	0	102	70	130				
Bromodichloromethane	470	56	562.9	0	83.1	70	130				
Bromoform	420	56	562.9	0	74.7	70	130				
Bromomethane	650	280	562.9	0	116	70	130				
Carbon disulfide	560	280	562.9	0	99.4	70	130				
Carbon tetrachloride	520	56	562.9	0	92.8	70	130				
Chlorobenzene	560	56	562.9	0	98.6	70	130				
Chloroethane	590	280	562.9	0	104	70	130				
Chloroform	550	56	562.9	0	98.3	70	130				
Chloromethane	430	56	562.9	0	76.8	70	130				
cis-1,2-Dichloroethene	600	56	562.9	0	106	70	130				
cis-1,3-Dichloropropene	530	56	562.9	0	93.4	70	130				
Dibromochloromethane	470	56	562.9	0	83.9	70	130				
Dibromomethane	550	56	562.9	0	97.8	70	130				
Dichlorodifluoromethane	350	56	562.9	0	61.9	70	130				S

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604884-001A	SampType: MS	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5970						
Client ID: ZZZZZZ	Batch ID: R5970	TestNo: SW8260B		Analysis Date: 5/1/2006	SeqNo: 88569						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dichloromethane	580	280	562.9	0	104	70	130				
Diethyl ether	590	280	562.9	0	105	70	130				
Ethyl methacrylate	550	56	562.9	0	98.3	70	130				
Ethylbenzene	550	56	562.9	0	97.4	70	130				
Ethylene dibromide	570	56	562.9	0	100	70	130				
Hexachlorobutadiene	480	280	562.9	0	85.5	70	130				
Hexachloroethane	420	56	562.9	0	74.8	70	130				
Isopropyl ether	600	280	562.9	0	106	70	130				
Isopropylbenzene	580	56	562.9	0	102	70	130				
m,p-Xylene	1,100	110	1,126	0	93.7	70	130				
Methyl ethyl ketone	1,600	280	562.9	0	278	70	130				
Methyl Iodide	530	280	562.9	0	94.9	70	130				S
Methyl isobutyl ketone	560	560	562.9	0	99.8	70	130				
Methyl tert-butyl ether	1,100	280	1,126	0	100	70	130				J
Naphthalene	540	280	562.9	0	96.4	70	130				
n-Butylbenzene	530	56	562.9	0	94.3	70	130				
n-Propylbenzene	550	56	562.9	0	97.4	70	130				
o-Xylene	510	56	562.9	0	91.2	70	130				
p-Isopropyltoluene	520	56	562.9	0	92.2	70	130				
sec-Butylbenzene	520	56	562.9	0	92.2	70	130				
Styrene	540	56	562.9	0	95.5	70	130				
t-Butyl alcohol	2,800	2,300	2,815	0	98.6	70	130				
tert-Amyl Methyl Ether	570	230	562.9	0	102	70	130				
tert-Butyl Ethyl Ether	570	280	562.9	0	102	70	130				
tert-Butylbenzene	530	56	562.9	0	94.4	70	130				
Tetrachloroethene	720	56	562.9	0	129	70	130				
Toluene	630	56	562.9	69.24	99.4	70	130				
trans-1,2-Dichloroethene	570	56	562.9	0	102	70	130				
trans-1,3-Dichloropropene	550	56	562.9	0	98.1	70	130				
trans-1,4-Dichloro-2-butene	620	56	562.9	0	110	70	130				
Trichloroethene	540	56	562.9	0	96.1	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

TestCode: SW_8260S

Sample ID: 0604884-001A	SampType: MSD	TestCode: SW_8260S	Units: µg/Kg-dry	Prep Date:	RunNo: 5970						
Client ID: ZZZZZZ	Batch ID: R5970	TestNo: SW8260B		Analysis Date: 5/1/2006	SeqNo: 88570						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,4-Dichlorobenzene	570	56	562.9	0	101	70	130	538.2	5.20	25	
2,2-Dichloropropane	790	56	562.9	0	141	70	130	771.2	2.59	25	S
2-Chloroethyl vinyl ether	430	560	562.9	0	76.1	70	130	433.4	0	25	J
2-Chlorotoluene	640	56	562.9	0	113	70	130	524.1	19.3	25	
2-Hexanone	820	2,800	562.9	0	145	70	130	817.4	0	25	JS
2-Methylnaphthalene	540	280	562.9	0	95.7	70	130	461.0	15.5	25	
2-Nitropropane	450	230	3,940	0	11.4	70	130	474.0	5.24	0	S
4-Chlorotoluene	620	56	562.9	0	110	70	130	511.7	19.2	25	
Acetone	1,500	2,800	562.9	0	259	70	130	1,537	0	25	JS
Acrylonitrile	560	280	562.9	0	98.7	70	130	583.7	4.94	25	
Benzene	600	56	562.9	0	106	70	130	578.7	2.78	25	
Bromobenzene	510	56	562.9	0	91.1	70	130	530.8	3.45	25	
Bromochloromethane	610	56	562.9	0	109	70	130	575.9	6.16	25	
Bromodichloromethane	480	56	562.9	0	84.7	70	130	467.8	1.91	25	
Bromoform	410	56	562.9	0	73.4	70	130	420.5	1.76	25	
Bromomethane	630	280	562.9	0	112	70	130	653.6	3.86	25	
Carbon disulfide	570	280	562.9	0	101	70	130	559.5	1.30	25	
Carbon tetrachloride	560	56	562.9	0	98.7	70	130	522.4	6.16	25	
Chlorobenzene	560	56	562.9	0	98.6	70	130	555.0	0	25	
Chloroethane	530	280	562.9	0	94.7	70	130	587.1	9.65	25	
Chloroform	590	56	562.9	0	104	70	130	553.4	5.92	25	
Chloromethane	460	56	562.9	0	82.5	70	130	432.3	7.16	25	
cis-1,2-Dichloroethene	560	56	562.9	0	99.7	70	130	595.6	5.94	25	
cis-1,3-Dichloropropene	550	56	562.9	0	98.2	70	130	525.8	5.01	25	
Dibromochloromethane	490	56	562.9	0	86.8	70	130	472.3	3.40	25	
Dibromomethane	550	56	562.9	0	97.1	70	130	550.5	0.718	25	
Dichlorodifluoromethane	370	56	562.9	0	66.3	70	130	348.4	6.86	25	S
Dichloromethane	600	280	562.9	0	106	70	130	583.7	2.29	25	
Diethyl ether	580	280	562.9	0	103	70	130	588.8	1.06	25	
Ethyl methacrylate	540	56	562.9	0	95.7	70	130	553.4	2.68	25	
Ethylbenzene	530	56	562.9	0	93.6	70	130	548.3	3.98	25	

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 0604884-001A		SampType: MSD	TestCode: SW_8260S		Units: µg/Kg-dry	Prep Date:			RunNo: 5970		
Client ID: ZZZZZZ		Batch ID: R5970	TestNo: SW8260B			Analysis Date: 5/1/2006			SeqNo: 88570		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Ethylene dibromide	530	56	562.9	0	95.0	70	130	565.7	5.63	25	
Hexachlorobutadiene	550	280	562.9	0	97.4	70	130	481.3	13.0	25	
Hexachloroethane	400	56	562.9	0	71.5	70	130	421.1	4.51	25	
Isopropyl ether	610	280	562.9	0	109	70	130	599.5	2.50	25	
Isopropylbenzene	570	56	562.9	0	100	70	130	576.4	1.87	25	
m,p-Xylene	1,100	110	1,126	0	97.1	70	130	1,055	3.51	25	
Methyl ethyl ketone	1,500	280	562.9	0	270	70	130	1,563	2.66	25	S
Methyl Iodide	570	280	562.9	0	101	70	130	534.2	5.93	25	
Methyl isobutyl ketone	520	560	562.9	0	92.4	70	130	561.8	0	25	J
Methyl tert-butyl ether	1,100	280	1,126	0	98.4	70	130	1,129	1.81	25	
Naphthalene	550	280	562.9	0	98.5	70	130	542.7	2.15	25	
n-Butylbenzene	560	56	562.9	0	99.6	70	130	530.8	5.47	25	
n-Propylbenzene	550	56	562.9	0	97.2	70	130	548.3	0.206	25	
o-Xylene	530	56	562.9	0	94.1	70	130	513.4	3.13	25	
p-Isopropyltoluene	530	56	562.9	0	94.0	70	130	519.0	1.93	25	
sec-Butylbenzene	540	56	562.9	0	95.3	70	130	519.0	3.31	25	
Styrene	550	56	562.9	0	97.2	70	130	537.6	1.76	25	
t-Butyl alcohol	2,600	2,300	2,815	0	93.9	70	130	2,775	4.90	25	
tert-Amyl Methyl Ether	570	230	562.9	0	101	70	130	571.9	0.296	25	
tert-Butyl Ethyl Ether	570	280	562.9	0	101	70	130	574.7	0.885	25	
tert-Butylbenzene	530	56	562.9	0	94.5	70	130	531.4	0.106	25	
Tetrachloroethene	880	56	562.9	0	155	70	130	723.9	18.9	25	S
Toluene	610	56	562.9	69.24	95.5	70	130	628.8	3.55	25	
trans-1,2-Dichloroethene	610	56	562.9	0	109	70	130	573.1	6.83	25	
trans-1,3-Dichloropropene	560	56	562.9	0	99.4	70	130	552.2	1.32	25	
trans-1,4-Dichloro-2-butene	560	56	562.9	0	99.3	70	130	620.3	10.4	25	
Trichloroethene	580	56	562.9	0	103	70	130	541.0	7.22	25	
Trichlorofluoromethane	560	56	562.9	0	99.4	70	130	509.4	9.37	25	
Vinyl chloride	540	45	562.9	0	95.9	70	130	507.2	6.24	25	
Xylenes, Total	1,600	170	1,689	0	96.1	70	130	1,569	3.39	25	
Surr: 4-Bromofluorobenzene	3,200		2,815		113	70	130		0	25	

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

TestCode: SW_8260S											
Sample ID: 0604884-001A		SampType: MSD		TestCode: SW_8260S		Units: µg/Kg-dry		Prep Date:		RunNo: 5970	
Client ID: ZZZZZZ		Batch ID: R5970		TestNo: SW8260B				Analysis Date: 5/1/2006		SeqNo: 88570	
Analyte		Result		PQL		SPK value		SPK Ref Val		%REC	
										LowLimit	
										HighLimit	
										RPD Ref Val	
										%RPD	
										RPDLimit	
										Qual	
Surr: Dibromofluoromethane		3,100				2,815				111	
Surr: Toluene-d8		3,000				2,815				70	
										130	
										0	
										25	
										107	
										70	
										130	
										0	
										25	
Sample ID: 10ug/L LCS1		SampType: LCS		TestCode: SW_8260S		Units: µg/Kg-dry		Prep Date:		RunNo: 5970	
		Batch ID: R5970		TestNo: SW8260B				Analysis Date: 5/1/2006		SeqNo: 88570	

Sample ID: 10ug/L LCS1		SampType: LCS	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5970					
Client ID: LCSS		Batch ID: R5970	TestNo: SW8260B		Analysis Date: 5/1/2006	SeqNo: 88582					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	460	50	500.0	0	91.3	70	130				
1,1,1-Trichloroethane	490	50	500.0	0	98.4	70	130				
1,1,2,2-Tetrachloroethane	480	50	500.0	0	96.3	70	130				
1,1,2-Trichloro-1,2,2-trifluoroethane	570	50	500.0	0	115	70	130				
1,1,2-Trichloroethane	510	50	500.0	0	102	70	130				
1,1-Dichloroethane	530	50	500.0	0	105	70	130				
1,1-Dichloroethene	520	50	500.0	0	104	70	130				
1,1-Dichloropropene	520	50	500.0	0	105	70	130				
1,2,3-Trichlorobenzene	540	50	500.0	0	107	70	130				
1,2,3-Trichloropropane	490	50	500.0	0	98.1	70	130				
1,2,3-Trimethylbenzene	470	50	500.0	0	93.3	70	130				
1,2,4-Trichlorobenzene	530	250	500.0	0	105	70	130				
1,2,4-Trimethylbenzene	500	50	500.0	0	99.2	70	130				
1,2-Dibromo-3-chloropropane	470	50	500.0	0	93.1	70	130				
1,2-Dichlorobenzene	510	50	500.0	0	102	70	130				
1,2-Dichloroethane	540	50	500.0	0	109	70	130				
1,2-Dichloropropane	500	50	500.0	0	99.8	70	130				
1,3,5-Trimethylbenzene	490	50	500.0	0	97.7	70	130				
1,3-Dichlorobenzene	500	50	500.0	0	100	70	130				
1,3-Dichloropropane	520	50	500.0	0	105	70	130				
1,4-Dichlorobenzene	530	50	500.0	0	106	70	130				
2,2-Dichloropropane	790	50	500.0	0	158	70	130				
2-Chloroethyl vinyl ether	410	500	500.0	0	82.1	70	130				S
2-Chlorotoluene	520	50	500.0	0	103	70	130				J
Qualifiers:											

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 10ug/L LCS1		SampType: LCS	TestCode: SW_8260S		Units: µg/Kg	Prep Date:		RunNo: 5970			
Client ID: LCSS		Batch ID: R5970	TestNo: SW8260B			Analysis Date: 5/1/2006		SeqNo: 88582			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
2-Hexanone	710	2,500	500.0	0	142	70	130				JS
2-Methylnaphthalene	780	250	500.0	0	156	70	130				S
2-Nitropropane	420	200	500.0	0	84.8	70	130				
4-Chlorotoluene	500	50	500.0	0	101	70	130				
Acetone	1,200	2,500	500.0	0	248	70	130				JS
Acrylonitrile	530	250	500.0	0	105	70	130				
Benzene	540	50	500.0	0	108	70	130				
Bromobenzene	490	50	500.0	0	97.5	70	130				
Bromochloromethane	580	50	500.0	0	116	70	130				
Bromodichloromethane	450	50	500.0	0	89.1	70	130				
Bromoform	400	50	500.0	0	80.5	70	130				
Bromomethane	520	250	500.0	0	103	70	130				
Carbon disulfide	540	250	500.0	0	109	70	130				
Carbon tetrachloride	520	50	500.0	0	103	70	130				
Chlorobenzene	510	50	500.0	0	102	70	130				
Chloroethane	530	250	500.0	0	107	70	130				
Chloroform	510	50	500.0	0	102	70	130				
Chloromethane	410	50	500.0	0	81.8	70	130				
cis-1,2-Dichloroethene	470	50	500.0	0	94.2	70	130				
cis-1,3-Dichloropropene	500	50	500.0	0	101	70	130				
Dibromochloromethane	460	50	500.0	0	91.4	70	130				
Dibromomethane	490	50	500.0	0	97.9	70	130				
Dichlorodifluoromethane	340	50	500.0	0	68.1	70	130				S
Dichloromethane	540	250	500.0	0	108	70	130				
Diethyl ether	520	250	500.0	0	103	70	130				
Ethyl methacrylate	480	50	500.0	0	95.4	70	130				
Ethylbenzene	500	50	500.0	0	99.1	70	130				
Ethylene dibromide	490	50	500.0	0	98.0	70	130				
Hexachlorobutadiene	580	250	500.0	0	116	70	130				
Hexachloroethane	440	50	500.0	0	87.5	70	130				
Isopropyl ether	560	250	500.0	0	112	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: 10ug/L LCS1	SampType: LCS	TestCode: SW_8260S	Units: µg/Kg	Prep Date:	RunNo: 5970						
Client ID: LCSS	Batch ID: R5970	TestNo: SW8260B		Analysis Date: 5/1/2006	SeqNo: 88582						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Isopropylbenzene	530	50	500.0	0	106	70	130				
m,p-Xylene	980	100	1,000	0	98.4	70	130				
Methyl ethyl ketone	940	250	500.0	0	189	70	130				
Methyl Iodide	470	250	500.0	0	94.5	70	130				S
Methyl isobutyl ketone	520	500	500.0	0	103	70	130				
Methyl tert-butyl ether	1,000	250	1,000	0	105	70	130				
Naphthalene	540	250	500.0	0	109	70	130				
n-Butylbenzene	530	50	500.0	0	106	70	130				
n-Propylbenzene	500	50	500.0	0	99.9	70	130				
o-Xylene	490	50	500.0	0	97.6	70	130				
p-Isopropyltoluene	500	50	500.0	0	100	70	130				
sec-Butylbenzene	510	50	500.0	0	102	70	130				
Styrene	490	50	500.0	0	98.8	70	130				
t-Butyl alcohol	2,500	2,000	2,500	0	99.9	70	130				
tert-Amyl Methyl Ether	520	200	500.0	0	104	70	130				
tert-Butyl Ethyl Ether	550	250	500.0	0	110	70	130				
tert-Butylbenzene	480	50	500.0	0	95.7	70	130				
Tetrachloroethene	490	50	500.0	0	97.9	70	130				
Toluene	520	50	500.0	0	104	70	130				
trans-1,2-Dichloroethene	530	50	500.0	0	106	70	130				
trans-1,3-Dichloropropene	520	50	500.0	0	104	70	130				
trans-1,4-Dichloro-2-butene	560	50	500.0	0	111	70	130				
Trichloroethene	500	50	500.0	0	99.4	70	130				
Trichlorofluoromethane	530	50	500.0	0	107	70	130				
Vinyl chloride	480	40	500.0	0	96.1	70	130				
Xylenes, Total	1,500	150	1,500	0	98.1	70	130				
Surr: 4-Bromofluorobenzene	2,800		2,500		111	70	130				
Surr: Dibromofluoromethane	2,700		2,500		109	70	130				
Surr: Toluene-d8	2,800		2,500		111	70	130				

Qualifiers: E Value above quantitation range H Holding times for preparation or analysis exceeded J Analyte detected below quantitation limit
 M Manual Integration used to determine area response ND Not Detected at the Reporting Limit R RPD outside accepted recovery limits
 RL Reporting Detection Limit S Spike Recovery outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: MBLK1 1.0mL		SampType: MBLK		TestCode: SW_8260S		Units: µg/Kg		Prep Date:		RunNo: 5970	
Client ID: PBS		Batch ID: R5970		TestNo: SW8260B		Analysis Date: 5/1/2006		SeqNo: 88583			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,1,1,2-Tetrachloroethane	ND	50									
1,1,1-Trichloroethane	ND	50									
1,1,2,2-Tetrachloroethane	ND	50									
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	50									
1,1,2-Trichloroethane	ND	50									
1,1-Dichloroethane	ND	50									
1,1-Dichloroethene	ND	50									
1,1-Dichloropropene	ND	50									
1,2,3-Trichlorobenzene	ND	50									
1,2,3-Trichloropropane	ND	50									
1,2,3-Trimethylbenzene	ND	50									
1,2,4-Trichlorobenzene	ND	250									
1,2,4-Trimethylbenzene	ND	50									
1,2-Dibromo-3-chloropropane	ND	50									
1,2-Dichlorobenzene	ND	50									
1,2-Dichloroethane	ND	50									
1,2-Dichloropropane	ND	50									
1,3,5-Trimethylbenzene	ND	50									
1,3-Dichlorobenzene	ND	50									
1,3-Dichloropropane	ND	50									
1,4-Dichlorobenzene	ND	50									
2,2-Dichloropropane	ND	50									
2-Chloroethyl vinyl ether	ND	500									
2-Chlorotoluene	ND	50									
2-Hexanone	ND	2,500									
2-Methylnaphthalene	ND	250									
2-Nitropropane	ND	200									
4-Chlorotoluene	ND	50									
Acetone	250	2,500									J
Acrylonitrile	ND	250									
Benzene	ND	50									

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: MBLK1 1.0mL		SampType: MBLK		TestCode: SW_8260S		Units: µg/Kg		Prep Date:		RunNo: 5970	
Client ID: PBS		Batch ID: R5970		TestNo: SW8260B				Analysis Date: 5/1/2006		SeqNo: 88583	
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Bromobenzene	ND	50									

Bromobenzene	ND	50									
Bromochloromethane	ND	50									
Bromodichloromethane	ND	50									
Bromoform	ND	50									
Bromomethane	ND	250									
Carbon disulfide	ND	250									
Carbon tetrachloride	ND	50									
Chlorobenzene	ND	50									
Chloroethane	ND	250									
Chloroform	ND	50									
Chloromethane	ND	50									
cis-1,2-Dichloroethene	ND	50									
cis-1,3-Dichloropropene	ND	50									
Dibromochloromethane	ND	50									
Dibromomethane	ND	50									
Dichlorodifluoromethane	ND	50									
Dichloromethane	130	250									
Diethyl ether	ND	250									J
Ethyl methacrylate	ND	50									
Ethylbenzene	ND	50									
Ethylene dibromide	ND	50									
Hexachlorobutadiene	ND	250									
Hexachloroethane	ND	50									
Isopropyl ether	ND	250									
Isopropylbenzene	ND	50									
m,p-Xylene	ND	100									
Methyl ethyl ketone	110	250									
Methyl iodide	ND	250									
Methyl isobutyl ketone	ND	500									J
Methyl tert-butyl ether	ND	250									
Naphthalene	ND	250									

Qualifiers: E Value above quantitation range

M Manual Integration used to determine area response

RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit

R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8260S

Sample ID: MBLK1 1.0mL		SampType: MBLK		TestCode: SW_8260S		Units: µg/Kg		Prep Date:		RunNo: 5970	
Client ID: PBS		Batch ID: R5970		TestNo: SW8260B		Analysis Date: 5/1/2006		SeqNo: 88583			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
n-Butylbenzene	ND	50									
n-Propylbenzene	ND	50									
o-Xylene	ND	50									
p-Isopropyltoluene	ND	50									
sec-Butylbenzene	ND	50									
Styrene	ND	50									
t-Butyl alcohol	ND	2,000									
tert-Amyl Methyl Ether	ND	200									
tert-Butyl Ethyl Ether	ND	250									
tert-Butylbenzene	ND	50									
Tetrachloroethene	ND	50									
Toluene	ND	50									
trans-1,2-Dichloroethene	ND	50									
trans-1,3-Dichloropropene	ND	50									
trans-1,4-Dichloro-2-butene	ND	50									
Trichloroethene	ND	50									
Trichlorofluoromethane	ND	50									
Vinyl chloride	ND	40									
Xylenes, Total	ND	150									
Surr: 4-Bromofluorobenzene	2,800		2,500		113	70	130				
Surr: Dibromofluoromethane	2,700		2,500		109	70	130				
Surr: Toluene-d8	2,700		2,500		107	70	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: LCS-2807	SampType: LCS	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5991						
Client ID: LCSS	Batch ID: 2807	TestNo: SW8270C		Analysis Date: 5/2/2006	SeqNo: 88913						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trichlorobenzene	770	330	1,667	0	46.2	50	130				S
2,4,5-Trichlorophenol	810	330	1,667	0	48.6	50	130				S
2,4,6-Trichlorophenol	760	330	1,667	0	45.7	50	130				S
2,4-Dichlorophenol	820	330	1,667	0	49.5	50	130				S
2,4-Dimethylphenol	840	330	1,667	0	50.2	50	130				S
2,4-Dinitrophenol	ND	330	1,667	0	0	50	130				S
2,4-Dinitrotoluene	820	330	1,667	0	49.3	50	130				S
2,6-Dichlorophenol	ND	330	1,667	0	0	50	130				S
2,6-Dinitrotoluene	950	330	1,667	0	57.3	50	130				S
2-Chloronaphthalene	820	330	1,667	0	49.1	50	130				S
2-Chlorophenol	790	330	1,667	0	47.2	50	130				S
2-Methylnaphthalene	780	330	1,667	0	46.7	50	130				S
2-Methylphenol	790	330	1,667	0	47.7	50	130				S
2-Nitroaniline	890	830	1,667	0	53.1	50	130				S
2-Nitrophenol	800	330	1,667	0	47.8	50	130				S
3,3'-Dichlorobenzidine	1,200	330	1,667	0	69.0	50	130				S
3/4 Methylphenol	770	330	1,667	0	45.9	50	130				S
3-Nitroaniline	1,000	830	1,667	0	62.7	50	130				S
4,6-Dinitro-2-methylphenol	ND	330	1,667	0	0	50	130				S
4-Chloro-3-methylphenol	920	280	1,667	0	55.0	50	130				S
4-Chloroaniline	880	330	1,667	0	52.9	50	130				S
4-Chlorophenyl phenyl ether	930	330	1,667	0	55.9	50	130				S
4-Nitroaniline	1,000	830	1,667	0	61.1	50	130				S
4-Nitrophenol	690	830	1,667	0	41.7	50	130				S
Acenaphthene	920	330	1,667	0	55.5	50	130				JS
Acenaphthylene	860	330	1,667	0	51.4	50	130				JS
Aniline	700	330	1,667	0	42.1	50	130				JS
Anthracene	930	330	1,667	0	55.9	50	130				JS
Benz(a)anthracene	950	330	1,667	0	57.0	50	130				JS
Benzdine	990	330	1,667	0	59.2	50	130				JS
Benzo(a)pyrene	980	330	1,667	0	59.1	50	130				JS

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: LCS-2807		SampType: LCS	TestCode: SW_8270S		Units: µg/Kg	Prep Date: 4/28/2006		RunNo: 5991			
Client ID: LCSS		Batch ID: 2807	TestNo: SW8270C			Analysis Date: 5/2/2006		SeqNo: 88913			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzo(b)fluoranthene	960	330	1,667	0	57.8	50	130				S
Benzo(g,h,i)perylene	760	330	1,667	0	45.9	50	130				
Benzo(k)fluoranthene	1,000	330	1,667	0	62.2	50	130				S
Benzoic acid	ND	3,300	1,667	0	0	50	130				JS
Benzyl alcohol	800	3,300	1,667	0	47.9	50	130				
Bis(2-chloroethoxy)methane	860	330	1,667	0	51.6	50	130				S
Bis(2-chloroethyl) ether	770	100	1,667	0	46.3	50	130				S
Bis(2-chloroisopropyl) ether	810	330	1,667	0	48.7	50	130				S
Bis(2-ethylhexyl) phthalate	2,500	330	1,667	0	150	50	130				
Butyl benzyl phthalate	1,000	330	1,667	0	62.5	50	130				
Carbazole	990	330	1,667	0	59.2	50	130				
Chrysene	950	330	1,667	0	57.0	50	130				S
Dibenz(a,h)anthracene	800	330	1,667	0	48.0	50	130				
Dibenzofuran	910	330	1,667	0	54.5	50	130				
Diethyl phthalate	970	330	1,667	0	58.5	50	130				
Dimethyl phthalate	880	330	1,667	0	52.9	50	130				BS
Di-n-butyl phthalate	3,900	330	1,667	0	236	50	130				
Di-n-octyl phthalate	1,200	330	1,667	0	72.8	50	130				
Fluoranthene	930	330	1,667	0	56.1	50	130				
Fluorene	910	330	1,667	0	54.8	50	130				
Hexachlorobenzene	890	330	1,667	0	53.2	50	130				S
Hexachlorobutadiene	790	50	1,667	0	47.5	50	130				S
Hexachlorocyclopentadiene	510	330	1,667	0	30.5	50	130				S
Hexachloroethane	740	300	1,667	0	44.7	50	130				S
Indeno(1,2,3-cd)pyrene	790	330	1,667	0	47.2	50	130				S
Isophorone	810	330	1,667	0	48.7	50	130				S
Naphthalene	790	330	1,667	0	47.3	50	130				S
Nitrobenzene	830	330	1,667	0	49.6	50	130				S
N-Nitrosodimethylamine	720	330	1,667	0	43.1	50	130				S
N-Nitrosodi-n-propylamine	760	330	1,667	0	45.9	50	130				S
N-Nitrosodiphenylamine	1,200	330	1,667	0	74.6	50	130				

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: LCS-2807	SampType: LCS	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5991						
Client ID: LCSS	Batch ID: 2807	TestNo: SW8270C		Analysis Date: 5/2/2006	SeqNo: 88913						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Pentachlorophenol	370	330	1,667	0	22.4	50	130				
Phenanthrene	950	330	1,667	0	57.0	50	130				S
Phenol	860	330	1,667	0	51.8	50	130				
Pyrene	990	330	1,667	0	59.5	50	130				
Pyridine	610	330	1,667	0	36.4	50	130				
Surr: 2,4,6-Tribromophenol	780		1,667		47.0	50	130				S
Surr: 2-Fluorobiphenyl	810		1,667		48.4	50	130				S
Surr: 2-Fluorophenol	760		1,667		45.6	50	130				S
Surr: Nitrobenzene-d5	820		1,667		49.2	50	130				S
Surr: Phenol-d5	850		1,667		51.2	50	130				S
Surr: Terphenyl-d14	960		1,667		57.4	50	130				

Sample ID: MB-2807	SampType: MBLK	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5991						
Client ID: PBS	Batch ID: 2807	TestNo: SW8270C		Analysis Date: 5/2/2006	SeqNo: 88924						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trichlorobenzene	ND	330									
1,4-Dichlorobenzene	ND	330									
2,4,5-Trichlorophenol	ND	330									
2,4,6-Trichlorophenol	ND	330									
2,4-Dichlorophenol	ND	330									
2,4-Dimethylphenol	ND	330									
2,4-Dinitrophenol	ND	330									
2,4-Dinitrotoluene	ND	330									
2,6-Dichlorophenol	ND	330									
2,6-Dinitrotoluene	ND	330									
2-Chloronaphthalene	ND	330									
2-Chlorophenol	ND	330									
2-Methylnaphthalene	ND	330									
2-Methylphenol	ND	330									
2-Nitroaniline	ND	830									

Qualifiers: E Value above quantitation range H Holding times for preparation or analysis exceeded J Analyte detected below quantitation limit
 M Manual Integration used to determine area response ND Not Detected at the Reporting Limit R RPD outside accepted recovery limits
 RL Reporting Detection Limit S Spike Recovery outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: MB-2807		SampType: MBLK		TestCode: SW_8270S		Units: µg/Kg		Prep Date: 4/28/2006		RunNo: 5991	
Client ID: PBS		Batch ID: 2807		TestNo: SW8270C		Analysis Date: 5/2/2006		SeqNo: 88924			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
2-Nitrophenol	ND	330									
3,3'-Dichlorobenzidine	ND	330									
3/4 Methylphenol	ND	330									
3-Nitroaniline	ND	830									
4,6-Dinitro-2-methylphenol	ND	330									
4-Chloro-3-methylphenol	ND	280									
4-Chloroaniline	ND	330									
4-Chlorophenyl phenyl ether	ND	330									
4-Nitroaniline	ND	830									
4-Nitrophenol	ND	830									
Acenaphthene	ND	330									
Acenaphthylene	ND	330									
Aniline	ND	330									
Anthracene	ND	330									
Benz(a)anthracene	ND	330									
Benzidine	ND	330									
Benzo(a)pyrene	ND	330									
Benzo(b)fluoranthene	ND	330									
Benzo(g,h,i)perylene	ND	330									
Benzo(k)fluoranthene	ND	330									
Benzoic acid	ND	3,300									
Benzyl alcohol	ND	3,300									
Bis(2-chloroethoxy)methane	ND	330									
Bis(2-chloroethyl) ether	ND	100									
Bis(2-chloroisopropyl) ether	ND	330									
Bis(2-ethylhexyl) phthalate	270	330									J
Butyl benzyl phthalate	ND	330									
Carbazole	ND	330									
Chrysene	ND	330									
Dibenz(a,h)anthracene	ND	330									
Dibenzofuran	ND	330									

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: MB-2807	SampType: MBLK	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 4/28/2006	RunNo: 5991						
Client ID: PBS	Batch ID: 2807	TestNo: SW8270C		Analysis Date: 5/2/2006	SeqNo: 88924						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diethyl phthalate	ND	330									
Dimethyl phthalate	ND	330									
DI-n-butyl phthalate	3,400	330									
DI-n-octyl phthalate	ND	330									
Fluoranthene	ND	330									
Fluorene	ND	330									
Hexachlorobenzene	ND	330									
Hexachlorobutadiene	ND	50									
Hexachlorocyclopentadiene	ND	330									
Hexachloroethane	ND	300									
Indeno(1,2,3-cd)pyrene	ND	330									
Isophorone	ND	330									
Naphthalene	ND	330									
Nitrobenzene	ND	330									
N-Nitrosodimethylamine	ND	330									
N-Nitrosodi-n-propylamine	ND	330									
N-Nitrosodiphenylamine	ND	330									
Pentachlorophenol	ND	330									
Phenanthrene	ND	330									
Phenol	ND	330									
Pyrene	ND	330									
Pyridine	ND	330									
Surr: 2,4,6-Tribromophenol	720		1,667		43.0	50	130				
Surr: 2-Fluorobiphenyl	800		1,667		47.9	50	130				S
Surr: 2-Fluorophenol	820		1,667		49.0	50	130				S
Surr: Nitrobenzene-d5	750		1,667		45.2	50	130				S
Surr: Phenol-d5	890		1,667		53.4	50	130				S
Surr: Terphenyl-d14	960		1,667		57.4	50	130				

Qualifiers: E Value above quantitation range
M Manual Integration used to determine area response
RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
ND Not Detected at the Reporting Limit
S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: 0604849-016BMS		SampType: MS	TestCode: SW_8270S		Units: µg/Kg-dry	Prep Date: 5/4/2006		RunNo: 6060			
Client ID: 18 @ 6.5-8'		Batch ID: 2885	TestNo: SW8270C			Analysis Date: 5/4/2006		SeqNo: 89957			
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trichlorobenzene	1,500	410	2,050	0	71.9	50	130				
2,4,5-Trichlorophenol	1,500	410	2,050	0	73.2	50	130				
2,4,6-Trichlorophenol	1,400	410	2,050	0	69.6	50	130				
2,4-Dichlorophenol	1,500	410	2,050	0	74.0	50	130				
2,4-Dimethylphenol	1,300	410	2,050	0	65.6	50	130				
2,4-Dinitrophenol	ND	410	2,050	0	0	50	130				S
2,4-Dinitrotoluene	1,600	410	2,050	0	80.1	50	130				
2,6-Dichlorophenol	ND	410	2,050	0	0	50	130				S
2,6-Dinitrotoluene	1,700	410	2,050	0	81.3	50	130				
2-Chloronaphthalene	1,400	410	2,050	0	68.9	50	130				
2-Chlorophenol	1,400	410	2,050	0	67.5	50	130				
2-Methylnaphthalene	1,400	410	2,050	1,177	10.2	50	130				S
2-Methylphenol	1,400	410	2,050	0	69.5	50	130				
2-Nitroaniline	1,400	1,000	2,050	0	69.3	50	130				
2-Nitrophenol	1,200	410	2,050	0	60.9	50	130				
3,3'-Dichlorobenzidine	1,400	410	2,050	0	68.7	50	130				
3/4 Methylphenol	1,500	410	2,050	0	71.0	50	130				
3-Nitroaniline	1,500	1,000	2,050	0	71.0	50	130				
4,6-Dinitro-2-methylphenol	630	410	2,050	0	30.6	50	130				S
4-Chloro-3-methylphenol	1,400	340	2,050	0	67.4	50	130				
4-Chloroaniline	1,200	410	2,050	0	60.6	50	130				
4-Chlorophenyl phenyl ether	1,400	410	2,050	0	67.0	50	130				
4-Nitroaniline	1,600	1,000	2,050	0	78.4	50	130				
4-Nitrophenol	1,500	1,000	2,050	0	71.4	50	130				
Acenaphthene	2,000	410	2,050	205.0	89.0	50	130				
Acenaphthylene	2,000	410	2,050	133.7	90.6	50	130				
Aniline	1,000	410	2,050	0	50.2	50	130				
Anthracene	5,300	410	2,050	520.7	235	50	130				S
Benz(a)anthracene	7,000	410	2,050	979.9	294	50	130				S
Benzidine	ND	410	2,050	0	0	50	130				S
Benzo(a)pyrene	6,300	410	2,050	578.1	277	50	130				S

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limit
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: 0604849-016BMS	SampType: MS	TestCode: SW_8270S	Units: µg/Kg-dry	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: 18 @ 6.5-8'	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89957						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzo(b)fluoranthene	8,200	410	2,050	1,173	341	50	130				S
Benzo(g,h,i)perylene	3,300	410	2,050	364.1	145	50	130				S
Benzo(k)fluoranthene	4,600	410	2,050	264.9	211	50	130				S
Benzolc acid	ND	4,100	2,050	0	0	50	130				S
Benzyl alcohol	1,300	4,100	2,050	0	62.2	50	130				J
Bis(2-chloroethoxy)methane	1,400	410	2,050	0	68.3	50	130				
Bis(2-chloroethyl) ether	1,300	120	2,050	0	63.9	50	130				
Bis(2-chloroisopropyl) ether	1,500	410	2,050	0	71.4	50	130				
Bis(2-ethylhexyl) phthalate	1,600	410	2,050	480.5	56.0	50	130				
Butyl benzyl phthalate	980	410	2,050	0	47.9	50	130				S
Carbazole	1,700	410	2,050	220.6	71.0	50	130				
Chrysene	12,000	410	2,050	1,308	518	50	130				S
Dibenz(a,h)anthracene	780	410	2,050	50.02	35.7	50	130				S
Dibenzofuran	2,000	410	2,050	545.3	70.4	50	130				
Diethyl phthalate	1,300	410	2,050	0	62.5	50	130				
Dimethyl phthalate	1,400	410	2,050	0	68.4	50	130				
Di-n-butyl phthalate	1,300	410	2,050	4,254	-143	50	130				S
Di-n-octyl phthalate	1,000	410	2,050	0	49.8	50	130				S
Fluoranthene	23,000	410	2,050	2,378	1,010	50	130				S
Fluorene	2,900	410	2,050	341.1	125	50	130				
Hexachlorobenzene	1,700	410	2,050	0	84.6	50	130				
Hexachlorobutadiene	1,200	62	2,050	0	58.5	50	130				
Hexachlorocyclopentadiene	ND	410	2,050	0	0	50	130				S
Hexachloroethane	1,000	370	2,050	0	51.1	50	130				
Indeno(1,2,3-cd)pyrene	3,500	410	2,050	370.6	154	50	130				S
Isophorone	1,300	410	2,050	0	65.6	50	130				
Naphthalene	2,000	410	2,050	605.2	68.2	50	130				
Nitrobenzene	1,400	410	2,050	0	66.1	50	130				
N-Nitrosodimethylamine	1,400	410	2,050	0	68.3	50	130				
N-Nitrosodi-n-propylamine	1,200	410	2,050	0	60.0	50	130				
N-Nitrosodiphenylamine	2,000	410	2,050	0	97.1	50	130				

Qualifiers: E Value above quantitation range

M Manual Integration used to determine area response

RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit

R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: 0604849-016BMS	SampType: MS	TestCode: SW_8270S	Units: µg/Kg-dry	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: 18 @ 6.5-8'	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89957						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Pentachlorophenol	1,200	410	2,050	0	56.3	50	130				
Phenanthrene	7,000	410	2,050	4,252	136	50	130				S
Phenol	1,600	410	2,050	0	77.8	50	130				
Pyrene	19,000	410	2,050	2,060	812	50	130				S
Pyridine	1,200	410	2,050	0	58.0	50	130				
Surr: 2,4,6-Tribromophenol	2,000		2,050		97.0	50	130				
Surr: 2-Fluorobiphenyl	1,400		2,050		69.5	50	130				
Surr: 2-Fluorophenol	1,400		2,050		69.0	50	130				
Surr: Nitrobenzene-d5	1,400		2,050		66.6	50	130				
Surr: Phenol-d5	1,500		2,050		71.9	50	130				
Surr: Terphenyl-d14	1,400		2,050		67.8	50	130				

Surr: Terphenyl-d14

Sample ID: 0604849-016BMSD	SampType: MSD	TestCode: SW_8270S	Units: µg/Kg-dry	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: 18 @ 6.5-8'	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89958						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trichlorobenzene	1,600	410	2,050	0	78.2	50	130	1,474	8.42	25	
2,4,5-Trichlorophenol	1,500	410	2,050	0	75.0	50	130	1,501	2.32	25	
2,4,6-Trichlorophenol	1,500	410	2,050	0	71.6	50	130	1,427	2.83	25	
2,4-Dichlorophenol	1,600	410	2,050	0	80.4	50	130	1,516	8.29	25	
2,4-Dimethylphenol	1,400	410	2,050	0	68.4	50	130	1,345	4.18	25	
2,4-Dinitrophenol	ND	410	2,050	0	0	50	130	0	0	25	S
2,4-Dinitrotoluene	1,500	410	2,050	0	74.2	50	130	1,642	7.68	25	
2,6-Dichlorophenol	ND	410	2,050	0	0	50	130	0	0	25	S
2,6-Dinitrotoluene	1,600	410	2,050	0	80.3	50	130	1,666	1.24	25	
2-Chloronaphthalene	1,500	410	2,050	0	70.9	50	130	1,412	2.86	25	
2-Chlorophenol	1,500	410	2,050	0	74.3	50	130	1,384	9.53	25	
2-Methylnaphthalene	1,500	410	2,050	1,177	15.2	50	130	1,387	7.07	25	S
2-Methylphenol	1,500	410	2,050	0	74.8	50	130	1,425	7.26	25	
2-Nitroaniline	1,500	1,000	2,050	0	74.2	50	130	1,420	6.91	25	
2-Nitrophenol	1,300	410	2,050	0	63.8	50	130	1,249	4.68	25	

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: 0604849-016BMSD SampType: MSD
 Client ID: 18 @ 6.5-8' Balch ID: 2885

TestCode: SW_8270S Units: µg/Kg-dry
 TestNo: SW8270C

Prep Date: 5/4/2006 RunNo: 6060
 Analysis Date: 5/4/2006 SeqNo: 89958

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
3,3'-Dichlorobenzidine	770	410	2,050	0	37.7	50	130	1,408	58.3	25	SR
3/4 Methylphenol	1,500	410	2,050	0	75.5	50	130	1,456	6.17	25	
3-Nitroaniline	1,400	1,000	2,050	0	68.2	50	130	1,456	4.14	25	
4,6-Dinitro-2-methylphenol	ND	410	2,050	0	0	50	130	626.5	0	25	S
4-Chloro-3-methylphenol	1,400	340	2,050	0	68.8	50	130	1,383	2.05	25	
4-Chloroaniline	1,300	410	2,050	0	64.2	50	130	1,242	5.77	25	
4-Chlorophenyl phenyl ether	1,400	410	2,050	0	70.2	50	130	1,373	4.72	25	
4-Nitroaniline	1,300	1,000	2,050	0	64.1	50	130	1,607	20.0	25	
4-Nitrophenol	1,100	1,000	2,050	0	54.7	50	130	1,465	26.6	25	
Acenaphthene	1,100	1,000	2,050	0	99.2	50	130	2,030	9.79	25	R
Acenaphthylene	2,200	410	2,050	205.0	55.7	50	130	1,990	7.84	25	
Aniline	1,800	410	2,050	133.7	83.2	50	130	1,030	10.3	25	
Anthracene	1,100	410	2,050	0	276	50	130	5,346	14.4	25	S
Benz(a)anthracene	6,200	410	2,050	520.7	164	50	130	7,012	47.2	25	SR
Benzidine	4,300	410	2,050	979.9	0	50	130	0	0	25	S
Benzo(a)pyrene	ND	410	2,050	0	194	50	130	6,262	31.6	25	SR
Benzo(b)fluoranthene	4,600	410	2,050	578.1	248	50	130	8,157	26.4	25	SR
Benzo(g,h,i)perylene	6,300	410	2,050	1,173	178	50	130	3,338	18.3	25	S
Benzo(k)fluoranthene	4,000	410	2,050	364.1	168	50	130	4,588	21.2	25	S
Benzoic acid	3,700	410	2,050	264.9	0	50	130	0	0	25	J
Benzyl alcohol	ND	4,100	2,050	0	65.2	50	130	1,274	0	25	
Bis(2-chloroethoxy)methane	1,300	4,100	2,050	0	74.1	50	130	1,401	8.14	25	
Bis(2-chloroethyl) ether	1,500	410	2,050	0	63.0	50	130	1,310	1.45	25	
Bis(2-chloroisopropyl) ether	1,300	120	2,050	0	76.2	50	130	1,465	6.45	25	
Bis(2-ethylhexyl) phthalate	1,600	410	2,050	0	70.0	50	130	1,629	16.1	25	
Butyl benzyl phthalate	1,900	410	2,050	480.5	44.0	50	130	982.4	8.62	25	S
Carbazole	900	410	2,050	0	74.7	50	130	1,677	4.35	25	
Chrysene	1,800	410	2,050	220.6	414	50	130	11,940	19.7	25	S
Dibenz(a,h)anthracene	9,800	410	2,050	1,308	89.7	50	130	782.3	82.9	25	R
Dibenzofuran	1,900	410	2,050	50.02	79.6	50	130	1,989	8.98	25	
Diethyl phthalate	2,200	410	2,050	545.3	64.2	50	130	1,281	2.72	25	
	1,300	410	2,050	0							

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: 0604849-016BMSD		SampType: MSD	TestCode: SW_8270S	Units: µg/Kg-dry	Prep Date: 5/4/2006	RunNo: 6060					
Client ID: 18 @ 6.5-8'		Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89958					
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Dimethyl phthalate	1,400	410	2,050	0	69.6	50	130	1,403	1.68	25	
Di-n-butyl phthalate	1,400	410	2,050	4,254	-141	50	130	1,314	3.61	25	S
Di-n-octyl phthalate	760	410	2,050	0	36.9	50	130	1,020	29.7	25	SR
Fluoranthene	17,000	410	2,050	2,378	715	50	130	23,090	30.2	25	SR
Fluorene	3,000	410	2,050	341.1	130	50	130	2,912	3.46	25	S
Hexachlorobenzene	1,700	410	2,050	0	84.7	50	130	1,733	0.142	25	
Hexachlorobutadiene	1,300	62	2,050	0	62.4	50	130	1,200	6.35	25	
Hexachlorocyclopentadiene	ND	410	2,050	0	0	50	130	0	0	25	S
Hexachloroethane	940	370	2,050	0	45.8	50	130	1,047	11.0	25	S
Indeno(1,2,3-cd)pyrene	4,000	410	2,050	370.6	179	50	130	3,529	13.6	25	S
Isophorone	1,400	410	2,050	0	68.3	50	130	1,345	4.06	25	
Naphthalene	2,100	410	2,050	605.2	73.7	50	130	2,004	5.45	25	
Nitrobenzene	1,400	410	2,050	0	69.0	50	130	1,355	4.38	25	
N-Nitrosodimethylamine	1,400	410	2,050	0	66.1	50	130	1,401	3.33	25	
N-Nitrosodi-n-propylamine	1,300	410	2,050	0	63.4	50	130	1,231	5.51	25	
N-Nitrosodiphenylamine	2,000	410	2,050	0	95.5	50	130	1,991	1.70	25	
Pentachlorophenol	810	410	2,050	0	39.3	50	130	1,155	35.6	25	SR
Phenanthrene	10,000	410	2,050	4,252	301	50	130	7,046	38.7	25	SR
Phenol	1,700	410	2,050	0	81.8	50	130	1,594	5.02	25	
Pyrene	15,000	410	2,050	2,060	620	50	130	18,700	23.5	25	S
Pyridine	1,200	410	2,050	0	56.2	50	130	1,188	3.08	25	
Surr: 2,4,6-Tribromophenol	1,800		2,050		89.5	50	130		0	25	
Surr: 2-Fluorobiphenyl	1,500		2,050		71.2	50	130		0	25	
Surr: 2-Fluorophenol	1,400		2,050		69.6	50	130		0	25	
Surr: Nitrobenzene-d5	1,400		2,050		67.8	50	130		0	25	
Surr: Phenol-d5	1,500		2,050		73.3	50	130		0	25	
Surr: Terphenyl-d14	1,300		2,050		61.2	50	130		0	25	

Qualifiers:	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation lin
	M	Manual Integration used to determine area response	ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits
	RL	Reporting Detection Limit	S	Spike Recovery outside accepted recovery limits		

CLIENT: Enviro Matrix, Inc.
 Work Order: 0604849
 Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: LCS-2885

SampType: LCS

TestCode: SW_8270S

Units: µg/Kg

Prep Date: 5/4/2006

RunNo: 6060

Client ID: LCSS

Batch ID: 2885

TestNo: SW8270C

Analysis Date: 5/4/2006

SeqNo: 89960

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
1,2,4-Trichlorobenzene	1,500	330	1,667	0	91.2	50	130				
2,4,5-Trichlorophenol	1,500	330	1,667	0	90.1	50	130				
2,4,6-Trichlorophenol	1,500	330	1,667	0	88.8	50	130				
2,4-Dichlorophenol	1,600	330	1,667	0	93.7	50	130				
2,4-Dimethylphenol	1,400	330	1,667	0	83.7	50	130				
2,4-Dinitrophenol	ND	330	1,667	0	0	50	130				
2,4-Dinitrotoluene	1,400	330	1,667	0	83.6	50	130				
2,6-Dichlorophenol	ND	330	1,667	0	0	50	130				
2,6-Dinitrotoluene	1,800	330	1,667	0	109	50	130				S
2-Chloronaphthalene	1,500	330	1,667	0	91.7	50	130				
2-Chlorophenol	1,400	330	1,667	0	85.1	50	130				
2-Methylnaphthalene	1,300	330	1,667	0	78.7	50	130				
2-Methylphenol	1,400	330	1,667	0	86.7	50	130				
2-Nitroaniline	1,400	830	1,667	0	84.5	50	130				
2-Nitrophenol	1,100	330	1,667	0	66.0	50	130				
3,3'-Dichlorobenzidine	2,800	330	1,667	0	167	50	130				
3/4 Methylphenol	1,300	330	1,667	0	81.0	50	130				
3-Nitroaniline	1,400	830	1,667	0	85.8	50	130				S
4,6-Dinitro-2-methylphenol	ND	330	1,667	0	0	50	130				
4-Chloro-3-methylphenol	1,400	280	1,667	0	85.3	50	130				
4-Chloroaniline	1,500	330	1,667	0	90.7	50	130				
4-Chlorophenyl phenyl ether	1,500	330	1,667	0	89.6	50	130				S
4-Nitroaniline	1,700	830	1,667	0	101	50	130				
4-Nitrophenol	1,100	830	1,667	0	65.9	50	130				
Acenaphthene	1,500	330	1,667	0	87.7	50	130				
Acenaphthylene	1,500	330	1,667	0	89.4	50	130				
Aniline	1,200	330	1,667	0	74.0	50	130				
Anthracene	1,600	330	1,667	0	97.4	50	130				
Benz(a)anthracene	1,300	330	1,667	0	79.8	50	130				
Benzidine	ND	330	1,667	0	0	50	130				
Benzo(a)pyrene	1,800	330	1,667	0	110	50	130				S

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.

Work Order: 0604849

Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: LCS-2885	SampType: LCS	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: LCSS	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89960						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzo(b)fluoranthene	2,000	330	1,667	0	117	50	130				
Benzo(g,h,i)perylene	1,900	330	1,667	0	116	50	130				
Benzo(k)fluoranthene	1,800	330	1,667	0	106	50	130				
Benzoic acid	ND	3,300	1,667	0	0	50	130				S
Benzyl alcohol	1,300	3,300	1,667	0	80.2	50	130				J
Bis(2-chloroethoxy)methane	1,500	330	1,667	0	90.2	50	130				
Bis(2-chloroethyl) ether	1,300	100	1,667	0	76.2	50	130				
Bis(2-chloroisopropyl) ether	1,500	330	1,667	0	92.4	50	130				
Bis(2-ethylhexyl) phthalate	1,600	330	1,667	0	93.2	50	130				
Butyl benzyl phthalate	1,400	330	1,667	0	85.8	50	130				
Carbazole	1,600	330	1,667	0	95.8	50	130				
Chrysene	1,500	330	1,667	0	88.7	50	130				
Dibenz(a,h)anthracene	2,000	330	1,667	0	120	50	130				
Dibenzofuran	1,500	330	1,667	0	90.9	50	130				
Diethyl phthalate	1,400	330	1,667	0	85.9	50	130				
Dimethyl phthalate	1,600	330	1,667	0	98.7	50	130				
Di-n-butyl phthalate	1,600	330	1,667	0	93.6	50	130				
Di-n-octyl phthalate	1,700	330	1,667	0	101	50	130				
Fluoranthene	1,500	330	1,667	0	91.0	50	130				
Fluorene	1,600	330	1,667	0	95.4	50	130				
Hexachlorobenzene	2,000	330	1,667	0	117	50	130				
Hexachlorobutadiene	1,300	50	1,667	0	77.8	50	130				
Hexachlorocyclopentadiene	1,200	330	1,667	0	69.1	50	130				
Hexachloroethane	1,200	300	1,667	0	70.2	50	130				
Indeno(1,2,3-cd)pyrene	1,900	330	1,667	0	114	50	130				
Isophorone	1,500	330	1,667	0	87.1	50	130				
Naphthalene	1,400	330	1,667	0	82.5	50	130				
Nitrobenzene	1,300	330	1,667	0	80.8	50	130				
N-Nitrosodimethylamine	1,500	330	1,667	0	87.1	50	130				
N-Nitrosodi-n-propylamine	1,300	330	1,667	0	80.8	50	130				
N-Nitrosodiphenylamine	2,100	330	1,667	0	125	50	130				

Qualifiers: E Value above quantitation range

M Manual Integration used to determine area response

RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit

R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: LCS-2885	SampType: LCS	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: LCSS	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89960						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Pentachlorophenol	920	330	1,667	0	55.4	50	130				
Phenanthrene	1,700	330	1,667	0	100	50	130				
Phenol	110	330	1,667	0	6.72	50	130				
Pyrene	1,600	330	1,667	0	94.4	50	130				JS
Pyridine	1,100	330	1,667	0	64.8	50	130				
Surr: 2,4,6-Tribromophenol	2,000		1,667		117	50	130				
Surr: 2-Fluorobiphenyl	1,500		1,667		92.2	50	130				
Surr: 2-Fluorophenol	1,500		1,667		89.0	50	130				
Surr: Nitrobenzene-d5	1,400		1,667		81.6	50	130				
Surr: Phenol-d5	1,500		1,667		92.3	50	130				
Surr: Terphenyl-d14	1,700		1,667		102	50	130				

Sample ID: MB-2885	SampType: MBLK	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: PBS	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89961						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

1,2,4-Trichlorobenzene	ND	330									
1,4-Dichlorobenzene	ND	330									
2,4,5-Trichlorophenol	ND	330									
2,4,6-Trichlorophenol	ND	330									
2,4-Dichlorophenol	ND	330									
2,4-Dimethylphenol	ND	330									
2,4-Dinitrophenol	ND	330									
2,4-Dinitrotoluene	ND	330									
2,6-Dichlorophenol	ND	330									
2,6-Dinitrotoluene	ND	330									
2-Chloronaphthalene	ND	330									
2-Chlorophenol	ND	330									
2-Methylnaphthalene	ND	330									
2-Methylphenol	ND	330									
2-Nitroaniline	ND	830									

Qualifiers:	E Value above quantitation range	H Holding times for preparation or analysis exceeded	J Analyte detected below quantitation lin
	M Manual Integration used to determine area response	ND Not Detected at the Reporting Limit	R RPD outside accepted recovery limits
	RL Reporting Detection Limit	S Spike Recovery outside accepted recovery limits	

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

Sample ID: MB-2885	SampType: MBLK	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: PBS	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89961						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

2-Nitrophenol	ND	330									
3,3'-Dichlorobenzidine	ND	330									
3/4 Methylphenol	ND	330									
3-Nitroaniline	ND	830									
4,6-Dinitro-2-methylphenol	ND	330									
4-Chloro-3-methylphenol	ND	280									
4-Chloroaniline	ND	330									
4-Chlorophenyl phenyl ether	ND	330									
4-Nitroaniline	ND	830									
4-Nitrophenol	ND	830									
Acenaphthene	ND	330									
Acenaphthylene	ND	330									
Aniline	ND	330									
Anthracene	ND	330									
Benz(a)anthracene	ND	330									
Benzidine	ND	330									
Benzo(a)pyrene	ND	330									
Benzo(b)fluoranthene	ND	330									
Benzo(g,h,i)perylene	ND	330									
Benzo(k)fluoranthene	ND	330									
Benzoic acid	ND	3,300									
Benzyl alcohol	ND	3,300									
Bis(2-chloroethoxy)methane	ND	330									
Bis(2-chloroethyl) ether	ND	100									
Bis(2-chloroisopropyl) ether	ND	330									
Bis(2-ethylhexyl) phthalate	ND	330									
Butyl benzyl phthalate	ND	330									
Carbazole	ND	330									
Chrysene	ND	330									
Dibenz(a,h)anthracene	ND	330									
Dibenzofuran	ND	330									

Qualifiers: E Value above quantitation range
 M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded
 ND Not Detected at the Reporting Limit
 S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation limit
 R RPD outside accepted recovery limits

CLIENT: Enviro Matrix, Inc.
Work Order: 0604849
Project: EDC - 05-008

QC SUMMARY REPORT

TestCode: SW_8270S

TestCode: SW_8270S											
Sample ID: MB-2885	SampType: MBLK	TestCode: SW_8270S	Units: µg/Kg	Prep Date: 5/4/2006	RunNo: 6060						
Client ID: PBS	Batch ID: 2885	TestNo: SW8270C		Analysis Date: 5/4/2006	SeqNo: 89961						
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Diethyl phthalate	ND	330									
Dimethyl phthalate	ND	330									
Di-n-butyl phthalate	ND	330									
Di-n-octyl phthalate	ND	330									
Fluoranthene	ND	330									
Fluorene	ND	330									
Hexachlorobenzene	ND	330									
Hexachlorobutadiene	ND	50									
Hexachlorocyclopentadiene	ND	330									
Hexachloroethane	ND	300									
Indeno(1,2,3-cd)pyrene	ND	330									
Isophorone	ND	330									
Naphthalene	ND	330									
Nitrobenzene	ND	330									
N-Nitrosodimethylamine	ND	330									
N-Nitrosodi-n-propylamine	ND	330									
N-Nitrosodiphenylamine	ND	330									
Pentachlorophenol	ND	330									
Phenanthrene	ND	330									
Phenol	ND	330									
Pyrene	ND	330									
Pyridine	ND	330									
Surr: 2,4,6-Tribromophenol	1,200		1,667		72.4	50	130				
Surr: 2-Fluorobiphenyl	1,300		1,667		77.0	50	130				
Surr: 2-Fluorophenol	1,200		1,667		72.0	50	130				
Surr: Nitrobenzene-d5	740		1,667		44.2	50	130				
Surr: Phenol-d5	1,300		1,667		78.3	50	130				S
Surr: Terphenyl-d14	1,500		1,667		90.8	50	130				

Qualifiers: E Value above quantitation range

M Manual Integration used to determine area response
 RL Reporting Detection Limit

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

S Spike Recovery outside accepted recovery limits

J Analyte detected below quantitation lin

R RPD outside accepted recovery limits



21

[illegible]

31578 Glenvale Street
Houston, TX 47503-3827

Phase 2: 1994-1995

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1962-1963

Please include Email Address of Report Recipient Whenever Possible !!!

SUBMITTING COMPANY Enviro Matrix, Inc.				REPORT TO Bridget Rohn Enviro Matrix, Inc.				BILL TO Enviro Matrix, Inc. 163 Madison, Suite 104 Detroit, MI 48226					
PROJECT NAME EDC		PROJECT # 05-008		QUOTE #		COMPANY		PHONE		FAX		EMAIL	
SPECIAL INSTRUCTIONS / COMMENTS Please call with any questions.								PHONE 313-464-1550		FAX 313-464-1770			
SAMPLER'S PRINTED NAME Bridget Rohn				SAMPLER'S SIGNATURE <i>Bridget Rohn</i>				ANALYTICAL PARAMETERS					
ITEM #	SAMPLE ID	DATE SAMPLED	TIME SAMPLED	APR	SOLID	FLUID	VOLUME	SAMPLE DESCRIPTION	NUM OF CONTAINERS	VOL (GAL)	PAV4	10% HCL	COMMENTS
11	14@4'-5.5'	4/24/04	1:24p		X		400		2		X	X	Please hold file for possible additional VOC analysis.
12	14@9'-10.5'	4/24/04	1:36p		X		400		2		X	X	
13	15@15'-3'	4/24/04	2:30p		X		400		2	X	X	X	
14	16@4'-5.5'	4/25/04	2:48p		X		400		1		X	X	
15	17@15'-3'	4/25/04	3:11p		X		400		1		X	X	
16	18@6.5'-8'	4/25/04	3:17p		X		400		2		X	X	
7													
8													
9													
10													

Registered By: <i>Karen Brull</i> Date: 4/27/04		Title: 913		Registered By: <i>J. P. Green</i> Date: 4/27/04		Title: 410	
Registered By: <i>O. P. Green</i> Date: 4/27/04		Title: 1447		Registered By: <i>A. Lott</i> Date: 4/27/04		Title: 1455	

TAT: Standard <input checked="" type="checkbox"/> RUSH: <input type="checkbox"/>				Note: RUSH request will incur surcharge!			
--	--	--	--	--	--	--	--

FOR LAB USE ONLY			
Were samples preserved? <input checked="" type="checkbox"/> in field <input type="checkbox"/> in lab	Were samples filtered? <input checked="" type="checkbox"/> in field <input type="checkbox"/> in lab	Total of samples: 38	
Comments:			



RTI LABORATORIES, INC.

CHAIN OF CUSTODY RECORD



API & GEL PERMEATION



RELAC GEL PERMEATION



MSE GEL PERMEATION



SEC. STATE DEPARTMENT

MAIN LAB & HEADQUARTERS

RTI LABORATORIES, INC.

31626 Glendale Street
Livonia, MI 48150-1827

Phone: (734) 777-0000

0604849

Please include Email Address of Report Recipient Whenever Possible!!

SUBMITTER'S COMPANY Enviro Matrix, Inc.				REPORT TO: Bridget Rohm				BILL TO: Enviro Matrix, Inc.							
PROJECT NAME: EDC		PROJECT #: 03-008		QUOTE #:		COMPANY: Enviro Matrix, Inc.				163 Madison, Suite 104					
SPECIAL INSTRUCTIONS / COMMENTS: Please call with any questions.								PHONE: 313-964-1550				Detroit, MI 48226			
								FAX: 313-964-1770				EMAIL: bridget@enviro-matrix.com			
SAMPLER'S PRINTED NAME: Bridget Rohm				SAMPLER'S SIGNATURE: <i>Bridget Rohm</i>				ANALYTICAL PARAMETERS							
ITEM #	SAMPLE ID	DATE SAMPLED	TIME SAMPLED	AP	SOLID	FLUID	VOLUME	SAMPLE DESCRIPTION	NO. OF CONTAINERS	VOL (L)	RNA	SEM-VOL	REAG-SAMPLE	MT VOLUME	COMMENTS
1	6 @ 4-5.5'	4/24/06			X		400		2	X		X	X		2. Please let the recipient know that the samples are for possible additional TCW analysis.
2	8 @ 6.5-8'	4/24/06			X		400		2	X		X	X		
3	6 @ 14-15.5'	4/24/06			X		200		2	X	X		X		
4	7 @ 9'-10.5'	4/24/06			X		200		2	X	X		X		
5	8 @ 12'-14'	4/24/06			X		200		2	X	X		X		
6	9 @ 9'-10.5'	4/24/06			X		200		2	X	X		X		
7	10 @ 6.5-10.5'	4/24/06			X		200		2	X	X		X		
8	11 @ 4.5'	4/25/06			X		400		2	X	X		X		
9	12 @ 2.5-3'	4/25/06	11:44a		X		400		2	X	X		X		
10	13 @ 1.5-2.5'	4/25/06	12:19p		X		400		2	X	X		X		
Retrieved By: <i>R. Ball</i>		Time: 4/27 9:13		Time: 4/27 14:47		Retrieved By: <i>D. P. Brown</i>		Time: 4/27 07:13		Time: 4-27-06 14:58		FOR LAB USE ONLY			
Relinquished By: <i>D. P. Brown</i>		Time: 4/27 14:47		Time: 4-27-06 14:58		Relinquished By: <i>D. P. Brown</i>		Time: 4-27-06 14:58		Time: 4-27-06 14:58		When samples preserved <input type="checkbox"/> at 4°C <input type="checkbox"/> at 16°C <input type="checkbox"/> NO			
Relinquished By:		Time:		Time:		Relinquished By:		Time:		Time:		When samples frozen <input type="checkbox"/> at 4°C <input type="checkbox"/> at 16°C <input type="checkbox"/> NO			
TAT: Standard <input checked="" type="checkbox"/> RUSH <input type="checkbox"/>		First BD <input type="checkbox"/> Second BD <input type="checkbox"/> Third BD <input type="checkbox"/>		Note: RUSH requests will incur surcharges.								Terms of samples: 5.8 14.6 On What is? <input checked="" type="checkbox"/>			
Distribution: Wire and Fax: Lab: PM: Field															
See reverse side for Laboratory Terms and Conditions of service															

To view, call the information number 1-800-850-1234



PHOTO 1:

PHOTO LOOKING NORTH-
NORTHEAST DURING
PLACEMENT OF SB-14.

APRIL 25, 2005

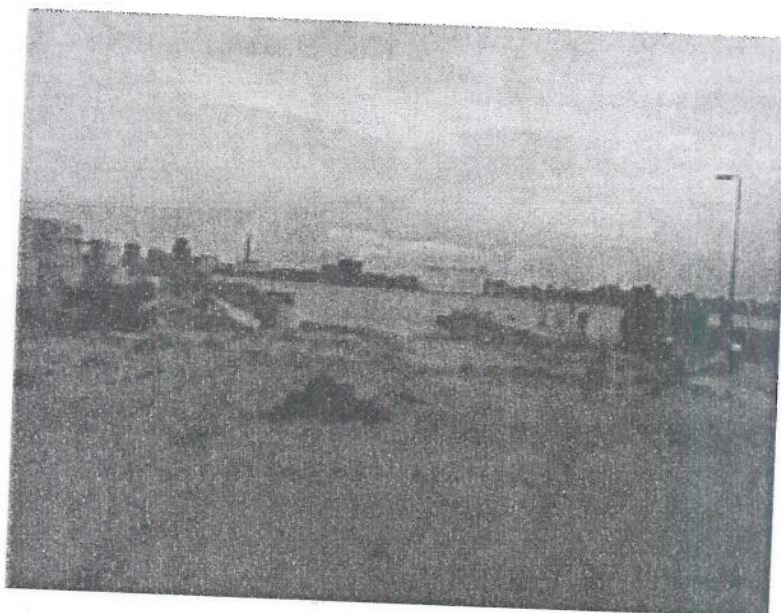


PHOTO 2:

PHOTO LOOKING SOUTH
AT DETROIT RIVER AND
SB-14.

APRIL 25, 2006

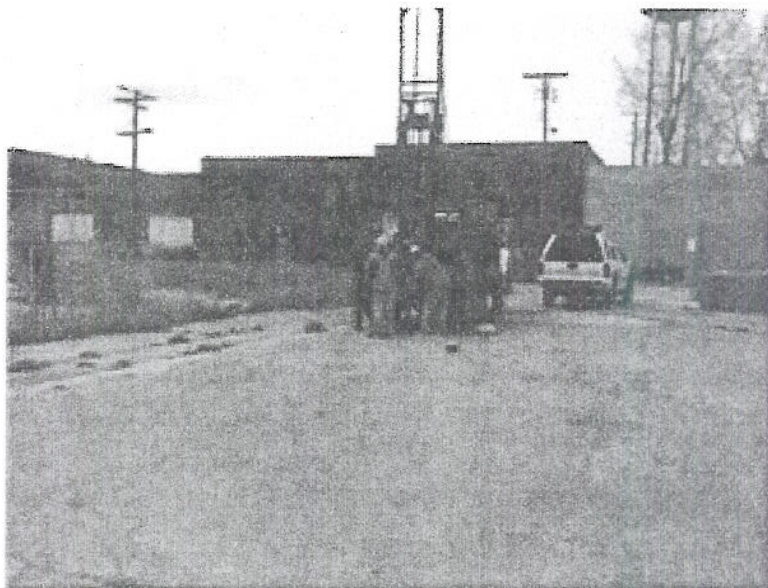


PHOTO 3:

PHOTO LOOKING
NORTHWEST DURING
PLACEMENT OF SB-18.

APRIL 25, 2006

BRIDGET G. ROHN

As an Environmental Scientist at Enviro Matrix, Inc., Bridget Rohn is responsible for Phase I, II Environmental Site Assessments, technical writing, sampling activities, biosolids application, and aspects of wastewater treatment projects. Ms. Rohn is experienced in the preparation of technical reports, sampling activities including water (surface and ground), soil, sludge, and air, as well as scaled drafting using AutoCAD. Ms. Rohn has worked on the design of a complex Biosolids based Residual Management Plan. Recently, Ms. Rohn has provided service as a project site leader and onsite engineering oversight technician for large scale decontamination and demolition projects.

Ms. Rohn combines her belief in strong communication and collaboration to accomplish Enviro Matrix's goal of excellence, a holistic and ecological viewpoint, and forward-looking approaches, with engineering standards. Ms. Rohn is dedicated to working closely with clients, and is responsible for organizing procedures, analyzing / synthesizing data, and administration of sampling.

Previously, Ms. Rohn held a laboratory position performing sample and data analysis at Michigan State University. This involved lab procedures, time-critical experiments and deadlines. She was published in "American Journal of Ecology & Viticulture" for research and data work and regularly devised more effective and innovative methods of lab procedures and organization. Ms. Rohn held a position with the U.S. Fish & Wildlife Service as a Biological Science Aid. She has experience working in harsh, extreme conditions and was certified in Commercial Pesticide Application - Aquatic, Michigan Department of Agriculture, CPR, and First-Aid. Ms. Rohn also earned an award for "Excellent Team Member".

Ms. Rohn received a Bachelor of Science degree in Environmental Biology and Zoology from Michigan State University in 2000. Ms. Rohn completed Laboratory Chemical Safety with the Office of Radiation, Chemical & Biological Safety and has earned her 40-hour HAZWOPER certification. Ms. Rohn has certification as a construction site stormwater operator. Ms. Rohn is currently pursuing graduate studies in Environmental Science. Ms. Rohn co-authored a paper on innovative Sewage Lagoon closure methods that she presented at the 2004 AEG conference.



KIRIT T RAVANI, P.E., CHMM

As President, owner and founder of the environmental and engineering consulting firm Enviro Matrix, Inc., Mr. Ravani provides overall management to his company as well as bringing to it his thirty-eight years of civil and environmental engineering experience. Previous to starting Enviro Matrix, Mr. Ravani served as Vice President for the City Management Corporation, Program Manager for General Motors, and group leader for Giffels Associates, Inc.

While at City Management, Mr. Ravani served as a client liaison and directed remedial efforts for plant decontamination, demolition, PCB treatment, underground and aboveground cleanup, TSCA, and RCRA projects.

While at General Motors Argonaut, Mr. Ravani managed construction and design projects including closure, decontamination, demolition, and design/construction/startup/training of wastewater treatment plants and operators. In 1988 he received special recognition for achieving the corporation's environmental compliance activities and for being extremely innovative and cost effective. This recognition came directly from General Motors Executive Committee.

While at Giffels Associates, Mr. Ravani served as group leader of many design and construction projects including Detroit's wastewater facilities planning project. The wastewater treatment and recycling projects included overall management and coordination involving some of Detroit's major corporations.

Some of Mr. Ravani's clients include General Motors, Collier's, Quorum Commercial., Texaco Corporation, Auragen Development, Walt Industries, Inc., Planet Machinery, Inc., MGM Grand Detroit, LLC, Wayne County, The City of Detroit and The State of Michigan.

Kirit Ravani has a Master of Science degree in civil/environmental engineering from Wayne State University and a Master's degree in Management from the University of Michigan. Mr. Ravani has been practicing environmental engineering in the Detroit area as a Michigan P.E. since 1973. He is a Certified Hazardous Material Manager, has been trained for RBCA process from ASTM and is a certified UST professional. Mr. Ravani has presented IWT operator courses at the Engineering Society of Detroit, technical papers at the Water Environmental Federation in Los Angeles and Singapore, Hazmat conference in Detroit and at the Machinery Dealers National Association in Chicago. Mr. Ravani co-authored a paper that was presented at the 2003 Brownfields Conference and 2004 AEG Conference on innovative Sewage Lagoon closure methods.

Mr. Ravani has served as Vice Chair on the Hazardous Waste Appeals Board for the City of Novi, Michigan, served on the Board for the Central Coastal Analytical Services Corporations, co-chaired The Engineering Society of Detroit (ESD) Environmental Response Planning Conference, organized and chaired ESD's Brownfield sites committee, and has served on the Detroit Regional Chamber's environmental committee. He chaired ESD's Fall 1999 Conference on Brownfield Redevelopment and Environmental Justice. Mr. Ravani also serves on the Environmental Justice Task Force for the Michigan Department of Environmental Quality. Mr. Ravani currently serves on the D.A.C.'s Strategic Planning Committee.

For his efforts in environmental activity and education, Mr. Ravani has received numerous leadership and recognition awards, and *The Detroit Free Press Business Section* published a profile of Mr. Ravani's entrepreneurship. The *D.A.C. News* published a feature on Mr. Ravani's business and personal successes this year.

